A PRIMER

OF

GENERAL METHOD

BEING

AN INTRODUCTION TO EDUCATIONAL THEORY AND PRACTICE ON THE BASIS OF LOGIC

FOR USE IN NORMAL SCHOOLS

BY

SIDNEY EDWARD LANG

PROVINCIAL NORMAL SCHOOL
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Education

PREFACE.

Educational science must seek for materials in many fields. The purpose here is to point out certain considerations drawn from the study of Logic which have a direct bearing upon educational theory and practice.

Psychology is almost invariably given a place on programmes for the training of teachers. It deals, however, with mental life in its structural aspects chiefly; and the educator cannot afford to omit or postpone the study of the functional side of mind. He is vitally interested in problems relating to the **value** or **validity** of cognitive processes which psychology aims simply to describe. He must enquire into the **value** of feeling as well as into its various forms. He cannot be satisfied with a mere description of volitional experience, but desires to go forward to a **valuation** of conduct. The three closely connected fields of logic, aesthetics, and ethics thus lie alongside that of psychology in a complementary relation which cannot be ignored in a programme of studies for Normal Schools.

Indeed, the beginner in educational science might far more easily dispense with Psychology than with Logic. In dealing with psychological abstractions, there is considerable danger of confusion on account of the com-

plexity of the matter when he attempts to analyze it into its structural "elements," and these are of less practical consequence than the behaviour of the concrete personality with whom he has to do. Logic, on the other hand, is a kind of mental physiology. It deals with the mind as performing certain acts with a purpose in view —the good of the organism—and compels the student to take a practical and objective view of the case.

The point of view in what follows is that knowledge is for action—that the method of knowledge has always been determined by practical considerations.

Setting out from the idea of the relativity of knowledge, much emphasis is laid on the conception of System, a highly convenient and adaptable working-tool for the teacher. An attempt is made in the second part of the book to make clear the meaning of Inference. Some acquaintance with the nature of Inference is absolutely indispensable to the teacher, since knowledge is inferential throughout. A further analysis of the idea of System gives us an insight into the nature of the inferential element in thinking. In Part III the two kinds of Inference are compared and contrasted. Here, again, the concept of System proves adequate to the use to which it is put, as it shows clearly the points of similarity and of difference in inductive and deductive inference. The value to the teacher of an acquaintance with these two kinds of procedure is so obvious that it hardly needs to be urged.

The first three parts of the book deal with Logic pure and simple. But the student of Education investigates the subject for a very practical purpose. He "wants to know," for very substantial and particular reasons of his own. He is not averse to enjoying whatever "liberalizing" value the study may confer, but what leads him to spend time upon it is not a mere antiquarian curiosity concerning fine logical distinctions, but his belief that a knowledge of Logic will guide him in a practical way in the work of education.

It is the business of the teacher of Logic in a Normal School to keep this in mind, and to avoid in the presentation of the subject all barren conceptions, all unnecessary distinctions—all matter, in short, that cannot be turned to practical account. He must furnish the student-teacher with a good working idea of intelligence as a knowing function—the mind in actual operation in the interest of the human organism.

Logic, it ought to be added, cannot do more than furnish very general guidance to the educator. Anyone who expects that it can supply him with a full and complete assortment of tricks, devices, short cuts, royal roads to knowledge, by means of which he may be enabled to "surprise the souls of his pupils into the act of learning," can only meet with disappointment. Logic offers no encouragement to a faith of that kind, but simply undertakes to show how knowledge has been gained in carrying out the purposes of life. It seeks to exhibit

the methods which have been most successful in the long and arduous task of building together the various parts of our knowledge.

With these considerations in view, there are gathered together in Part IV some salient facts of Logic which are of special significance for the student of educational science, in that they bear directly upon the definition of education, on the problem of laying out a programme of studies, and on the educational value of work, play, and drudgery.

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PART I.—THE GENERAL NATURE OF KNOWLEDGE.

CHAPTER I.

THE IDEAL OF KNOWLEDGE.

§1. Facts and their Interpretation.—We are constantly trying to find out the meaning of things. No one is satisfied to learn "the facts of the case," merely. The distinction between a fact and its significance, between a phenomenon and its meaning is one which everybody recognizes in ordinary intercourse. One often hears the remark: "There is no doubt that such and such are the facts. Now what is the right interpretation of these facts?"

It is not that "facts" are always easily ascertained. On the contrary, as we shall see, the discovery of the true facts in any given matter very frequently requires the most careful and accurate observation, and it is an easy thing to make serious mistakes in regard to the simplest facts. But the possession of a fact, or of the facts, is only a step on the road to explanation.

A fact, or a phenomenon, may mean more to one person than to another. A patient, for example, may be quite as well aware of certain features of the disorder from which he is suffering as is the physician himself to whom he gives an account of them. The physician may be able to interpret these features as indicative of the presence of a certain disease. To the patient they may, perhaps, be almost meaningless. Or, on the other hand, he may attach an entirely erroneous significance to them, A bit of red cloth waving in the wind may attract the attention of a young child as readily as that of a grown man. The child sees a patch of bright colour and says it is pretty. The man sees the same thing and calls it a flag. A certain appearance of the sky may mean little or nothing to the landsman. It is full of significance to the practised eye of the sailor.

In looking over our past experience we notice that the explanations which seem quite satisfactory at one stage of our experience, are discarded later on in favour of others. The Santa Claus theory is readily accepted by most children to account for the presence of the Christmas toys. Later on this theory gives place to another, less romantic perhaps, but more in accordance with the other parts of their experience. Other innocent deceptions ordinarily practised upon children, such as the work of the Dustman and the like, serve as illustrations of the fact that added experience and reflection have the effect of modifying or entirely setting aside explanations which satisfied us at first.

At a slightly advanced stage of knowledge we see the same process going on. In childhood the most simple and obvious explanation of the succession of day and night is the one usually adopted: namely, that the sun goes down on one side and moves round to the other during the night. This theory is held until forced out by a more adequate one. A small child accounted for the waving of the branches of the trees on the ingenious theory that far off some strong man set the air in motion by moving a huge tree back and forth, each tree carrying the impulse forward. Later experience failed to justify his belief in the big man, and the explanation was finally abandoned for another which fitted better with the rest of his knowledge. Sooner or later you give up the idea that thunder is due to the sudden bumping together of two great clouds, and that success in picking berries is directly traceable to your having thrown the first one over your left shoulder.

The history of science is the history of discarded explanations. We are told that the theory that Nature abhors a vacuum was at one time put forward to account for the operation of the lifting-pump. When it was found that water could not be lifted in this way higher than thirty-four feet a new explanation was required and found. Our present theory regarding the solar system supplanted a far less satisfactory one. Geology is another example of a branch of knowledge in which successive additions to our store of facts necessitated a re-construction of theories to account for them.

The ordinary affairs of life illustrate this process. The answer to the question: "who broke the window?" or "why does not this machine go?" will change with every new fact that we observe as related to the matter in hand. If a village child is lost, the searchers will form and abandon theory after theory in turn modifying each to suit the facts as they are established. The detective forms his theory and follows his clue. He frequently has occasion to drop one theory and form a new one as new facts come unmistakably into view.

§2. Knowledge and Superstition.—The "superstitious" notions of savages are simply to be regarded as more or less clumsy though quite honest and earnest attempts to understand, to interpret, to give a meaning to what they observe. The mental history of the race has been continuous, and the present stage of advancement in knowledge is the result of continuous, persistent effort by successive generations of men to find a meaning for the phenomena that surround them. There have been, it is true, considerable periods of time during which the progress made was very slight. Indeed it would appear as if at times the race remained at a standstill or even went backward in point of knowledge. Further, among the lower orders of the people many of the superstitions of an earlier day still retain a controlling influence upon their lives.

The persistence of superstitious notions is partly to be accounted for, no doubt, by a certain mental inertia

which is difficult to overcome. It is probably due in part also to the fact that one's beliefs very largely determine one's conduct. Habits and customs are notoriously hard to change, and primitive beliefs retain their influence by reason of being connected with individual and social practices which have become habitual. The savage is interested in things only in so far as they seem likely to benefit or injure him in a vital manner. He cannot see very deep into things in general, but to whatever extent he investigates nature he does it in a very earnest way, because he has his food to get and his enemies to avoid or destroy. Things are interesting to him, not because they lend themselves to neat logical classification, but because he wants to obtain possession of them or to keep out of their way. He forms opinions about things always with a view to action. These berries are to be avoided. Those roots are to be eagerly sought. Certain marks in the forest are a sign of danger. A malevolent deity haunts the grove or pool. To ask the savage to change his opinions in these matters is, therefore, to require not only a real effort of thought but a radical change in his habits of life and conduct as well.

With the modern civilized man, as well as with the savage, as long as an explanation or theory works fairly well it is believed. It is only when our interpretation fails us in an unmistakable way that we begin to feel dubious about it. As knowledge advances, however, we

do not find ourselves yielding quite so ready and eager an assent as in the case of our earlier beliefs.

"Blind confidence," says Bain,[1] "is the primitive attitude of our mind." A real change of opinion is indicated by a change in our conduct. When we no longer believe that success in raising corn depends on its being planted with reference to the moon's phases our change of belief is exhibited in a change in our mode of acting in that matter.

§3. **Explanation and "System."**—The distinction between a fact and its meaning has been sufficiently emphasized. We have seen that observation is only a step, though a very important one, on the way to explanation. While it is desirable to distinguish these processes from each other as clearly as possible, it is necessary at the same time to realize that they are very closely related to each other, that explanation simply carries forward towards completion the organizing work already begun by observation. What we are now specially concerned with is what is involved in explanation. When may we say that anything, a fact, or an event, or a phenomenon has been explained?

A boy picks up from the road a piece of metal of a certain size and shape. He begins to examine it with a view to understanding its meaning. It is certainly a step forward to be able to see that one end of the object has been formed to receive a nut; and a further

[1] Logic, Deductive and Inductive, Book VI, Chapter iii.

advance has been made when the object has been described as a steel bolt of such a length and diameter. The explanation, however, is not to be regarded as complete until one knows exactly the part which the bit of metal occupies in the total structure to which it belongs. It would hardly be sufficient to say that it "looks like some part of a self-binder." Explanation requires a definite account of its place and purpose.

On a piece of paper certain combinations of letters appear, some of them easily recognized and others indistinguishable. At first sight the characters are meaningless. But you set yourself to the task of interpretation, of finding a meaning for what is observed. You can make out the letters m, t and h. The first letter of the word is evidently a capital. Your explanation is that the word is a familiar proper name.

In the springtime you observe that there is borne about on the wind a quantity of light down. This phenomenon is explained by showing what happens in the life of poplar trees at this time of year. A patch of red on the horizon at night may be accounted for as due to a prairie fire, or a burning straw stack, or the rising moon. One of these is probably the true explanation, though each of them appears fairly plausible. An eclipse is explained by showing the relative position of certain of the planets at the time of the occurrence.

What, now, is the characteristic feature of all the cases presented? There seems to be an effort in each instance

to show the connection between the fact or phenomenon to be explained and some other fact or group of facts. In the first of these examples the boy saw the relation between the bit of metal that he found and the various other bits of metal and wood that go together to form a certain very useful machine. An acquaintance with the word Smith in the next example enables one to connect the second, forth and last letters with the missing ones so as to form an intelligible whole. So of the other instances. There is exhibited, or there is an attempt to exhibit, the connection between the flying downy material and a certain set of facts in the life of the poplar; to show the relation between the streak of red cloud and what we know of the condition of the prairie grass at the time of year; to bring together into one view the fact of the eclipse with a number of other facts which are lumped together under the name of the solar system.

The last mentioned example furnishes us with a term which we shall have to use pretty frequently in the course of the discussion. The terms 'system' and 'systematic' are the most convenient that can be used in connection with the problem of explanation. Explanation is always systematic, has reference to a system of one kind or another. To explain a thing, in short, is to give it an appropriate place in a system.[1] It will be necessary in order to a clear understanding of this

[1] "The conception of system determines all man's attempts at organizing knowledge." —Welton, The Logical Basis of Education, Chap i, § 8.

statement to enquire what exactly is meant by a system.

Ordinary usage furnishes us with numerous examples in such phrases as the solar system, a river system, a mountain system, the nervous system (digestive, respiratory, circulatory, etc.), a railway system, a system of water-works. The word is also used in a large variety of cases to indicate plans or ways of accomplishing a purpose, and we have different systems of government, the elective system applied to many things, judicial, educational and industrial systems, as well as "systems" of managing a business or an election contest, of acquiring wealth, of teaching shorthand or the piano, of cleaning the streets, of ventilating a room, of curing disease. Again, the purpose of such phrases as systematic theology, systematic botany, a system of logic, a philosophical system, a peculiar system of morality, is to emphasize the orderly character of the arrangement of the ideas presented in each of these fields of thought.

It is clear that our definition of the term must be broad enough to cover a large number of cases. The essential feature seems to be that of the relation or connection or arrangement of a number of things, or qualities, to form a complete whole. Relation, or connection of parts within a whole would be a shorter way of expressing the idea. The orderly connection of parts is emphasized in the definition of system as "a complex whole whose parts are congruently arranged."[1] We

[1] J. G. Hibben, Inductive Logic, Chap. i, p. 7.

may, perhaps, realize this more clearly when we definitely contrast the idea of system with that of a mere aggregate. "A system is a whole composed of various parts. But it is not the same thing as an aggregate or heap. In a heap of grain, or pile of stones one may take away any part without the other parts being at all affected thereby. But in a system each part has a fixed and necessary relation to the whole and to all the other parts."[1]

Another important feature of a system is that given one set of facts within it you are able to infer the rest. Thus, to take a very simple instance, the greater portion of any given object such as a house or a waggon may be hidden from your view. Only a very small part of it may be actually in sight. Your knowledge of the whole system, however, enables you, on the basis of what was presented to your view, to think of all the other parts. It is this feature of system which is brought out in the following:—"How can one property or attribute determine another, so that you can say, 'given this, there must be that?' This can only be answered by pointing to the nature of a whole with parts, or a system, which just means this, a group of relations or properties or things so held together by a common nature that you can judge from some of them what the others must be."[2] In this view of system we see that

[1] James Edwin Creighton, An Introductory Logic, Chap. xxi, § 78.

[2] B. Bosanquet, The Essentials of Logic, Lecture ix, § 3.

any part of a systematic whole receives its character, significance, or meaning from the relations in which it stands to the other parts and to the whole. Interdependence of parts is the feature here emphasized.

It may be well to consider a few examples of system in the light of what has been said. First we may observe that the systems within the scope of any one's knowledge are simply countless. It may be convenient to take some of our illustrations from familiar objects which we see around us every day. But it would, of course, be a mistake to suppose that the phrase "a whole composed of various parts" denotes only spatial wholes. It certainly includes many objects in space, but it includes other wholes as well. The British Constitution, the theory of winds, Protection, these are systems in quite as true a sense as a watch, a telephone exchange, or a battleship.

A house may be taken as an example for consideration. It is clearly, in the first place, a whole made up of parts. The various parts are related to each other in a certain way. Further, they are related not merely in the way in which the various parts of a "mere aggregate," as a heap of stones, or of sand, or of brick, or of lumber, or of nails are related to each other. Before a house is built, the various materials collected together for the building simply lie alongside of each other in a quite external relation. When the house is built, each part stands to every other in a fixed and necessary relation.

This bit of timber is now something more than a bit of timber. It has a new character or meaning. And this new character is due to its relation to the other parts and to the whole structure. Finally, the nature of the completed whole is such that you easily see how the idea of one part presupposes—leads naturally and inevitably to the others.

These features may readily be traced in the case of a triangle. The parts which compose the whole stand in certain peculiar relations to each other. A triangle is something more than so many lines. It is more than merely the sum of its parts. If we carefully consider its inner structure, we are able to discover a number of features which are connected or held together in such a way that "you can tell from some of them what the others must be"

We can conceive a state of society, a stage of civilization, in which the power enjoyed by the sovereign should for a time permit of his demanding and receiving from his subjects whatever taxes he chose to levy, according to his momentary caprice. Such taxes would at one moment bear heavily and unfairly upon one class or individual, while other classes or individuals would be favoured. Rich and poor might alternately be plundered, some individuals being ruined and others enriched. If the term "system" were employed at all to characterize such a proceeding, it would likely be qualified by the addition of the word "arbitrary" to indicate its depend-

ence upon the capricious will of the ruler, rather than upon reason. In such a case, no one could tell from the character and circumstances of one man's contribution to the general fund what his neighbour's was likely to be. The amounts demanded from each tax-payer would bear no necessary relation to each other. Contrast this case with that of any plan of raising money for national or civic purposes in our own country, and the differences that come immediately into view will serve to exhibit the true nature of system. The point to be noticed, of course, is not that all modern plans for raising taxes are perfectly just and equitable. But they are systematic; whereas the proceeding above mentioned would be rightly regarded as arbitrary, irrational, unsystematic.

A speaker occasionally announces his intention of treating the subject of his discourse under such and such heads, and his speech is, among other things, an attempt to exhibit the relation of these various topics to his main theme. He may, on the other hand, plunge into his subject without any preliminary announcement of the plan in his mind. But as he proceeds, his hearers can usually, to a considerable extent, anticipate the further course of his ideas by reason of the fact that he thinks, as we say, systematically, or according to a system. That is, the various parts of the whole discourse are "so held together by a common nature that you can tell from some of these what the others must be."

§4. The Test of a True Explanation.—The meaning of system as illustrated by the examples given should now be tolerably clear, and with it the meaning of the statement that to explain anything is to give it an appropriate place in a system. But we shall have to go a little further and enquire how we are to satisfy ourselves that any given explanation is the true one. It has already been pointed out that there are within the range of one's knowledge a very great many systems, that there is a vast deal of disagreement between individuals in regard to these systems, that in each individual case one's whole life has been engaged in changing one opinion or explanation for another, and that in general the history of science exhibits a continuous change from one set of "scientific truth" to another set, each giving place to its successor in turn. How does it come about that the explanations which were so satisfying in childhood fail to satisfy us now? It is not that the earlier explanations were not systematic, because, as we have seen, every attempt at explanation is made with a system of some kind in view. It cannot be that we are more likely to believe in the "true" explanation rather than in the inadequate one, as we know there is much difference of opinion among individuals. Different men hold most tenaciously to diametrically opposed ideas and "beliefs." What, then, is the test of a true explanation?

The reason why we cast aside one explanation and adopt others is because new facts have come into view,

Our knowledge has become wider than before, and there is a conflict between our explanation and our new bit of experience. We desire to harmonize all the parts of our knowledge as far as possible, and if a newly observed fact does not fit in with the rest of our experience we set ourselves at once to the task of re-adjusting our systems of thought. Consistency with the rest of our knowledge then, appears, in this view, to be the test we are seeking. This, we shall see, is at any rate a partial answer to the question.

A difficulty arises at this point, however, which requires further definition of our test. A question may be raised as to the possibility of a comprehensive system which is false, but consistent. We often hear it said that if a man tells a lie he is compelled to tell a good many more if he desires to back up the first one. Those who lie awkwardly are of course soonest found out. And, similarly, some errors are more easily detected than others, because they are so manifestly inconsistent with our settled notions of things. But the idea of an organized body of opinion, a quite self-consistent system of error on a large scale suggests itself as a possibility. We have seen that on a small scale such systems do command belief, and the question forces itself upon us: what further test have we to depend on besides the test of consistency with the rest of our knowledge?

The best answer in sight seems to be that our further and final test must be a practical one. We spend time

and labour in the study of the world about us for a very practical purpose. We desire to know what things are like in order that we may act rightly. Knowledge is of no use to us except in so far as it furnishes a guide for conduct. We must therefore ask, regarding any explanation that is offered for our acceptance, does it serve us in our daily life? The phrase, a "good working hypothesis" emphasizes this idea. An explanation or theory that works well, that we can live by and continue to live by we regard as true. One that does not help us, that fails as a guide to conduct we rightly consider false.

Summary.—The ideal of knowledge is a systematic explanation of the world. We are not contented simply to add impression to impression and detail to detail as if we were a giddy crowd of sightseers keen for mere sensation. We seek an explanation for what we observe, first making sure that we have observed accurately, and then casting about for an adequate explanation of the matter. The mental history of each individual, as well as that of the race, if written out in full would give an account of the way in which one explanation or interpretation has succeeded another in the various fields of knowledge. In all cases an explanation is retained and believed in as long as it serves as a guide for action. If it fails in this respect it is set aside and a better one sought. To explain anything is to give it an appropriate place in a system. The term system has been

variously defined, all the definitions we have examined emphasizing the idea of a whole composed of parts related to each other in a certain way, each detail or part within the whole getting its essential character from its connection with the rest. Our test of a true explanation is the simple one which has always been employed. As we seek out truth only that we may act rightly, it is but natural to regard as true whatever proves a safe and sure guide to right action.

CHAPTER II

KNOWLEDGE AS RELATED TO OUR PRACTICAL INTERESTS.

§5. Human Needs and the Range of Mental Activity.—If a person were able to map out the whole extent of his knowledge at any given time, it could readily be shown to correspond accurately to the range of his practical or instinctive and aesthetic interests. If, in addition to this, he could tell the particular order in which the various portions of his knowledge had been added, bit by bit, such account would suggest most strikingly the succession of such interests dominant in his life from time to time.

A few illustrations are better than much exposition. A savage is likely to know the character of the roots and fruits that are to be found in his locality, and when and where he must go, in order to secure possession of them He knows what fish can be taken from the lake or river, and the appliances for taking them. He is familiar with the tracks of the wild animals that he requires for food or clothing. He has learned the habits of other animals which he has the best reasons for wishing to avoid. He has sufficient insight into the properties of things about him to enable him to get the food, clothing and ornaments he needs for himself and his family, to build and secure his dwelling, and to kill his enemy. If he cannot do these things, he is aware that he will come to an

unhappy end, and is, therefore, particularly zealous in acquiring knowledge in these and similar fields. He may know enough of astronomy and geography to enable him to make his way across a plain on a starlight night; or of zoology, to recognize and distinguish certain animals from each other; or of the science of government, to guide him in keeping his family or tribe together. Every part of his knowledge that has been mentioned, and every part that might be mentioned, is strictly relative to some practical interest. Further, to see the correspondence between new fields of knowledge and the emergence of a new interest, we have only to imagine our savage engaged for the first time in defensive war against a marauding band, with strange methods of warfare, or driven forth from his native glen or coast, to make a new home in a strange land. The hard, practical necessities of the case compel him to extend his knowledge of suitable means of defence against his enemies. He must make new weapons; the materials necessary for their construction must be sought and found, the possibilities and limitations of their effective use clearly understood. This extension of his knowledge is unmistakably due to the new turn in his affairs. He studies the situation because he must do so in order to live—because of his practical interest in the case. The changes spoken of in his new home surroundings bring with them another extension of his knowledge. The means of subsistence here are of a different sort from

those in his old home. The natural difficulties of his situation are not the same. He may now, perhaps, be interested in flocks and herds; and in response to the imperative requirements of his new situation, he learns to extend his knowledge in a new direction.

The case of the savage is typical, not special. A little reflection will show us that we are, all of us, in a like predicament. That is to say, our knowledge and our practical interests correspond; or to put it another way, if a given thing be of absolutely no interest to a man, if it make no difference whatever to him, then his attitude towards it is a negative attitude,—the thing is not a real thing to him, and he cannot be said to have any real knowledge of it.

One's practical interests, *e.g.*, the necessity of making a living, or the desire to gain wealth, may lead one into mercantile life. The condition of trade, the wants of one's customers, the quality of goods, the rise and fall of prices, the expense account, bad debts, the bank, the trade journal, advertising, the board of trade, import duties, railway facilities, the wholesale house,—all these, and their like, are matters of knowledge, more or less accurate, to the merchant. If he be a mere merchant and nothing more his knowledge does not extend beyond them. So with the husbandman or the professional nurse, the schoolboy or the wealthy woman of fashion. Whatever is as a matter of fact the dominant interest in any case will be found to determine the

general character of the knowledge possessed. Most people, fortunately, have more than one interest or group of interests, and their knowledge corresponds. That which is very near to our practical interests is to us very real. That which affects our practical interests more remotely, less nearly, is to us less real. That which makes no difference whatever to us stands at the zero point as regards reality,—it is not real to us; we *know* nothing of it.

§6. **The Element of Purpose in all our Ideas.**—The extent of one's knowledge at any given time corresponds to the range of one's interests; and the various stages of progress in getting knowledge correspond to the order in which the dominant interests have asserted themselves. It is true of all real knowledge, then, since it is sought in all cases with a definite view to conduct, that there may be found the suggestion of a purpose, a "plan of action,"[1] in every idea we possess.

It should not be difficult to show that this is the case, if illustrations are convincing. Let us attempt to give the meaning of a few terms in ordinary use. Are we not compelled finally to state the meaning of a thing in terms of what it is used for? A waggon is something that we use for carrying loads. A knife is to cut with, a pen to write with, a chair to sit on. Food is something to eat, a pest something to be destroyed. A crop is something which is to be planted, tended and gathered. Ice is

[1] Dewey, Studies in Logical Theory, p. 348.

for skating or for curling or for hockey, or for keeping things cool for the table. The occupations of men (work and play) are infinitely various, and as they carry this idea of purpose on their face, need no more than a passing mention. As to theories, "scientific" and other, when we say we consider them true we do so because we can shape our conduct accordingly, and when we say they are false we mean that they are "useless." "If your practical experience suggests to you that a certain conception would be useful, *if it were true*, you will reasonably give it a trial to see if it is not "true," and if thus you discover it and find that you can work with it, you will certainly call it true, and believe that it is "true," and has been so from all eternity, and all this the more confidently and profoundly, the more extensively useful it appears."[1] The suggestion of a purpose or plan of action is not hard to find in ideas like the Monroe doctrine, the cause of the typhoid epidemic, the theory of winds, or provincial rights. Subtract from any of these the purposive element and the remainder is not worth considering.

It is, perhaps, an unnecessary waste of time to restate laboriously what has already been said so convincingly on this subject. In explaining what is meant by a mode of conceiving, Professor James, in his "Principles of Psychology,"[2] writes:—"There is no property absolutely

[1] F. C. S. Schiller, Humanism, pp. 36 and 77,

[2] Chap. xxii.

essential to any one thing. The same property which figures as the essence of a thing on one occasion becomes a very inessential thing upon another. Now that I am writing, it is essential that I conceive my paper as a surface for inscription. If I failed to do that, I should have to stop my work. But if I wished to light a fire, and no other materials were by, the essential way of conceiving the paper would be as combustible material; and I then need have no thought of its other destinations. It is really *all* that it is: a combustible, a writing surface, a thin thing, a hydrocarbonaceous thing, a thing eight inches one way and ten another, a thing just one furlong east of a certain stone in my neighbour's field, an American thing, etc., etc., ad infinitum. Whichever one of these aspects of its being I temporarily class it under, makes me unjust to the other aspects. But as I am always classing it under one aspect or another, I am always unjust, always partial, always exclusive. My excuse is necessity,—the necessity which my partial and finite nature lays upon me. My thinking is first and last and always for the sake of my doing, and I can only do one thing at a time.

The objection: "A thing's essence makes it *what* it is. Without an exclusive essence it would be nothing in particular, would be quite nameless—we could not say it was this rather than that. What you write on, for example,—why talk of its being combustible, rectangular, and the like, when you know that these are mere acci-

dents, and that what it really is, and was made to be, is just *paper*, and nothing else,"—James treats simply as an illustration of the point under discussion. The objector "is himself merely insisting on an aspect of the thing which suits his own petty purpose—that of *naming* the thing; or else on an aspect which suits the manufacturer's purpose—that of *producing an article for which there is a vulgar demand.* Meanwhile the reality overflows these purposes at every pore. Our usual purpose with it, our commonest title for it, and the properties which this title suggests, have in reality nothing sacramental. They characterize *us* more than they characterize the thing. But we are so stuck in our prejudices, so petrified intellectually, that to our vulgarest names, with their suggestions, we ascribe an eternal and exclusive worth."

§7. **Work and Drudgery in the Working-Day World.**—The plans of action which we form for ourselves are naturally relative to our desires and interests, and in forming such plans we are, of course, limited by the means at our disposal for carrying them out. There is a peculiar character of vividness, liveliness, and firmness which our knowledge possesses when it is gained in the course of carrying out plans of action which we have chosen for ourselves. These qualities are present to whatever degree we have really identified ourselves with the end in question, and have sought out and employed means suitable to the attainment of the end. And it

is notorious that what we come in contact with, while engaged in carrying out plans imposed upon us by other people, makes but little impression upon our minds, is relatively unreal to us, adds but little to our stock of knowledge.

The lawyer's clerk who spends his time in the unwilling drudgery of copying out legal papers will possess but an apology for real knowledge of the matter in hand. Law and all its concerns are little or nothing to him. His own plans may relate to gardening, mechanics, or athletics; and in so far as he is able to work at such plans, and as long as he is engaged in carrying them out or thinking about them, he is living in a real world, his knowledge of these matters is clear and vivid, his progress is sure and rapid.

Work, play, and drudgery alike are familiar enough experiences to most of us. When we are actually engaged in any one of these activities there is not the smallest doubt in our minds that we *are* working, or playing, or drudging, as the case may be. There is a fourth activity that might be mentioned in this connection which for want of a better word we shall call ***dissipation.*** And in practice there is no difficulty in recognizing the fact that play at a certain point passes into dissipation, just as work may become drudgery when the store of nervous energy has been overdrawn.

Familiar as these experiences are we yet have difficulty in stating in so many words the exact nature of each.

Can these four activities or occupations, for example, be distinguished by the presence or absence of the element of *pleasure?* Is the *kind* of pleasure we get from work the same as that which we get from play? Is there any difference between the kind of pleasure we get from play and that which we get from dissipation? Is it possible to set forth the differences between these four forms of expression by comparing the amount and kind of *effort* involved in each case? Or are the distinctions here based upon the matter of *choice* of means and ends? These and many other questions are bound to arise in any serious discussion of the nature of the activities mentioned.

One fact sticks out prominently in sight of every one everywhere, and that is that these activities cannot be distinguished from each other by any marks to be found on the outside. That is to say, the distinguishing feature of the case which makes play *play* and work *work* is in the mind of the individual so employed. We often say that what is work to one is play to another and drudgery to a third. The mental attitude is the determining feature in every case.

Hence we may add that what is work to an individual to-day may quite easily become drudgery to-morrow to the same individual on account of some change in his mental attitude, a change which may have been brought about in any one of a thousand ways. Not the least important of these may have been the accident of a

variation in bodily health and the amount of physical energy on call. The same remark will be seen to apply equally and obviously to the relation between play and dissipation.

By the phrase "mental attitude" we must understand, of course, the whole of one's thoughts and desires, needs, hopes and fears, tastes, likes and dislikes at any given time, as these take on definite form and colour and connect themselves in systems relative to the plans of action which we form for ourselves or which are formed for us by some outside authority. There is a peculiar kind of satisfaction that comes with the successful carrying out of our plans, which cannot be mistaken for any other kind of pleasure. Everyone is acquainted with this type of experience in a greater or less degree. Ordinarily we speak of the "interest" we take in what is going forward; of the "difficulties" to be overcome; and of the "satisfaction" we enjoy in overcoming these difficulties, in gaining the object of our desire, in carrying out, in short, the plan of action, the purpose which we have conceived and which we have set ourselves to achieve.

The interest spoken of is always present in work and absent in drudgery. By this it is not meant that work and drudgery always differ as sharply from each other and are as distinct and as easily distinguishable as black and white. The mental attitude which was spoken of above is not to be thought of as a fixed and unchanging

attitude. Fortunately there is an alacrity in mental life just as there is in the physical life a certain degree of alertness. And so, as an ordinary thing, we pursue our different plans of action with varying degrees of interest and with no absolutely rigid and unvarying determination. Nevertheless, we do find ourselves, in the case of certain occupations at least, at what may be called the zero point of interest, and when we pass this point we properly describe our occupation as one of drudgery.

It will be seen at once that the presence of interest is due to our having formed plans of action for ourselves, or what is practically the same thing, to our having adopted, and identified ourselves with, a plan formed or suggested by someone else. To say that you are "interested" in any given matter is simply another way of saying that there are certain plans which you have formed to which the given matter bears a certain definite relation. When you "lose interest" in anything, it is because the thing spoken of has drifted outside of the range of your plans of action. When you become "interested" you find yourself thinking about the "interesting" thing as likely to come into a more or less important place within the system of your life's activities.

There need be no more, or greater, objective difficulties, impediments, obstacles, obstructions, or hindrances in the case of drudgery than in the case of work. The difference between the two is in the mind, in the plans and purposes of the individuals concerned. But there is in work a

satisfaction which is absent from drudgery. The drudge, in short, does not look upon the occupation in which he is engaged, as really involving *the solution of a problem;* and hence he cannot enjoy any of the satisfaction of the worker in the contemplation of the finished product, of a problem solved, of difficulties overcome.

We have noticed that play is an activity which may readily degenerate into dissipation on account of the absence of a real interest: just as for that reason, work may pass into drudgery. Whenever the end to be reached is outside the range of one's practical interests, and where, therefore, the pressure of external authority is required to produce the necessary activity, you have slavery or drudgery. It is something the same in the case of play. Play when a certain stage is reached tends to slide into dissipation. It passes over the boundary just as soon as the free activity—which is its chief characteristic—has disappeared. In dissipation we have instead of this free activity a forced activity, and an accompanying pleasure brought about by the use of increasingly strong incentives and stimuli. The longer the process is continued, the greater the stimulus required as a spur to the jaded appetite or desire. Real activity becomes relatively less and less with the decrease of true interest which is its inner spring. In dissipation as in drudgery, the individual is, as it were, acted upon by forces outside of himself.

Summary.—The pursuit of knowledge is determined by practical and aesthetic interests. At any given time the range of a man's knowledge corresponds to the range of these interests, and the degree of reality of his knowledge is strictly relative to the nearness or remoteness of the matter to such interests. The end of knowledge is conduct, and our way of conceiving anything is always "what am I to do with this?" and not merely "what is it?" When, therefore, we have no choice of action, but follow an occupation or course of action unwillingly, we gain but little knowledge. Knowledge is sometimes said to be the product of leisure. As a matter of fact it is the product of work. But it is never the product of drudgery. The reason of this may be stated briefly: the drudge does not give his attention to the matter in hand, and hence cannot acquire knowledge.

CHAPTER III.

KNOWLEDGE AS MENTAL CONSTRUCTION.

§8. Construction, Physical and Mental.—A good deal has been said in a general way in the foregoing chapters about the work done by the mind in getting knowledge. We are now to look a little more closely at this feature of knowledge, as it seems desirable to emphasize the fact that knowledge does not come to us ready made, but is the result of effort and activity.[1]

In the physical process of building you have in the first place a purpose and a plan; you have certain materials available for the purpose spoken of; and finally you have a process of selection and adaptation of these materials resulting in the accomplishment of the purpose, the completed building.

Broadly speaking and avoiding unnecessary refinements of analysis, these features are present in every intelligent act of physical construction. It is true the plans which we set before us may vary greatly in definiteness from the first vague general idea to the carefully constructed plan of an architect drawn to a scale, with every square inch of space duly accounted for. But vague or definite, a plan of some kind we start with in every case.

Materials, of course, are relative to our purpose and to our means. The purpose we have in mind, that is to

[1] Cf. Creighton, Op. cit., Chap. xiii, §48.

say, guides us in our search for materials for building Obviously it would never do to seize the first thing that came to hand with the view of giving it a place in the structure. The purpose which the building is to serve must determine the character of the materials to be employed. We are further limited by the means at our disposal for securing the kind of material our purpose demands, and may be compelled to use what is inferior or insufficient to the full realization of the end we have in view.

An ample supply of the most desirable materials in the world, however,—stone, brick, lime, sand, timber, iron, glass—is not a house. The purpose and the materials are essential; but you must select and adapt these materials bit by bit, with your plan always in view, until by continued systematic effort the house is built.

Thinking is a mental, not a physical process; but here you have a purpose—that of interpretation—and a plan of action; you have, or rather you must gather, your facts, your materials for thought; and you must select, omit, try, and adapt these materials so as to form a systematic whole.

It is well to bear in mind that this is only a comparison, and that the mental process—*thinking*—does not correspond, point for point, with the physical process of building. There is, however, similarity enough to warrant us in saying that thinking is constructive.

We have already seen that in getting knowledge we are guided by a definite purpose—that of finding out the meaning of things (§ 1). No one seriously sets before himself the task of adding fact to fact, as a miser adds dollar to dollar, for the love of mere possession. We instinctively look for a meaning for each fact that we become aware of. Indeed, in strictness, as we shall see, it is only in so far as intelligence has succeeded in its task of interpretation that we are entitled to speak of any presentation as a "fact." Also we have already seen that our only excuse for trying to find out the meaning of things is that we desire to act wisely in regard to them. And so we may say that our purpose is in the first place that of right conduct; this purpose determines our attitude towards things in general: we must interpret them rightly,—knowing as we do that wrong interpretation of what we observe is likely to lead to mistakes in action; and this latter purpose again guides us in our search for facts.

Let us consider the case of an explorer. He travels about from place to place gathering information about the region in question with a view, let us say, to the capabilities of the district as a field for colonization. Almost everything in connection with climate, soil, minerals, animal and vegetable life is grist for his mill, or perhaps we had better say meal for his bake-shop. Every fact would be eagerly seized upon and carefully noted.

Suppose, again, an engineer going through the same territory looking out a line for a road. In this case the knowledge sought relates to the lie of the country, the streams which must be bridged, the tunnels, cuttings and grades. The facts to be observed are of a different kind from those sought by the explorer. As in actual physical building you are guided by your purpose as to whether you shall employ brick or stone or timber, so in getting knowledge you are guided by the purpose in hand as to whether you shall collect this or that or the other group of facts.

Consider, finally, the process by which facts are arranged into a systematic whole. We have spoken of this process as one of mental construction. As we have seen this process certainly involves a great deal of selection. Not every fact is considered worth the special attention of the explorer, but only those necessary to the purpose in hand. Selection involves omission. Further, the facts are put together in a certain way. In the explorer's mind when he has finished his task there is systematic knowledge of the country he has been studying. The facts he has discovered are not all equally important. Hence they do not occupy the same position of prominence in his view of them. The facts of great importance stand out in the foreground of his thought. Others are in subordinate positions. In short his knowledge may be regarded as a whole made up of parts which stand in certain relations to each other.

§9. Perception as Constructive.—The constructive activity of thought is not confined to a few special cases of knowledge getting. On the contrary it is at work at every stage as well in sense-perception as in the higher flights of imagination and reasoning.

Imagination partakes of this feature of construction in so large a degree that it is unnecessary to do more than refer to it. We must not forget that imagination plays a very important part in intellectual life. It is not the mere idle play of fancy that is spoken of. Imagination is at work in all the practical affairs of life. Wherever we have occasion to decide upon a course of action we must represent to ourselves the possible consequences of each step. Imagination is necessary in the abstractions of thought as well as in concrete work. Constructive activity is required in the successful pursuit of any branch of study. The hypotheses, theories, laws, and systems of the great scientific discoveries are one and all the result of this constructive feature of thought activity. Historical investigation involves arrangement of great masses of social, industrial and political phenomena.

A little reflection will show how the matter stands even in ordinary sense-perception. At first we may be inclined to think that in the perception of an object the mind is passive, that all we have to do is to open our eyes and look. But in order to get knowledge by means of the senses, something more than this is

really necessary. The fact that we are frequently mistaken in our judgments about things about us, points directly to the constructive activity of the mind in perception. The child sees, in the dim, half-light of his bedroom, strange and fearful shapes on the wall, which his elders interpret very differently. Our senses give us merely the materials out of which we construct. Lines may be drawn on paper to represent a rectangular prism which we can look at either from above or from below, according as we construct and reconstruct it in thought. A misplaced letter in a familiar word often passes unnoticed in reading, on account of our habit of constructing as we go along.

§ 10. **Our Separate Worlds.**—Each of us thus builds his own world. The work of the mind does not consist in merely acting the part of a mirror which reflects something standing before it. The mind is active, and only in so far as it is so is knowledge possible.

Ordinary language attests this by the use of such phrases as the political world, the business world, the educational world, a narrow world, the world of a blind man, and the like. The world of a business man differs from that of a "scientist," because each has employed his own methods of construction. To the former, certain things are commodities to be bought and sold. To the man of science, they are perhaps chemical or mechanical combinations of various "elements."

Compare the world of an artist with that of a man colour-blind; or the world of a musical with that of a non-musical person. The differences can be fairly guessed by those who possess but a fair degree of ability in such matters. They recognize their limitations, and the possibilities which lie open to those with higher capacities. A clergyman's world differs from that of an architect. The former glances at a church building, and an enormous number of ideas of worship, doctrine, his duties to his flock and the like, immediately pass through his mind. The latter may look at the same building, and there is called up an equally large number of ideas of a different character. He thinks of materials, construction, style, lighting, cost, etc.

Many people are addicted to the habit of building castles in Spain, and many in the midst of untoward surroundings live a life of their own—a life of ideas and ideals. These are simply illustrations of the fact we have before us that each of us builds his own world.

In commenting upon the feature of knowledge which we are now considering, Bosanquet asks[1] "how it happens that our separate worlds . . . . . do not contradict one another?" and answers the question as follows:—"The answer is that they *correspond.* It is this conception from which we must start in Logic. We must learn to regard our separate worlds of knowledge as something constructed by definite processes, and

[1] Essentials of Logic, p. 17.

corresponding to each other in consequence of the common nature of these processes. We know that we begin apart. We begin, in fact, though not conscious of our limits, with feelings and fancies and unorganized experiences which give us little or no common ground and power of co-operation with other people. But as the constructive process advances, the correspondence between our worlds is widened and deepened, and the greater proportion of what we are obliged to think is in harmony with what other people are obliged to think. Now, of course, this would not be so unless reality, the whole actual system in which we find ourselves, were self-consistent? But more than that, it would not be so unless the nature of intelligence were the same in every mind. It is this common nature of intelligence, together with its differentiated adaptations to reality, that we have to deal with in logic."

Again, the same writer says of the constructive work of thought that,—"We should know that correspondence implies a degree of identity, but also that every degree, from mere correspondence upwards, had to be won and justified by intellectual work; the *onus*, so to speak, of establishing it would be thrown on the intellect; and the progressive coincidence of our separate worlds would be the reward of knowledge. The moral of such a view is not a bad one; for it places the solidarity of mankind in the intellectual life."[1]

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[1] Logic, Vol. I. Introduction, p. 45.

Summary.—A certain constructive activity of mind is necessary to the acquisition of knowledge. Facts do not come to us ready made. The raw material is presented to us by the senses. Guided by a special purpose in every case, we set to work selecting and arranging and forming this material into an orderly structure—a systematic whole. As knowledge advances, the separate worlds in which we live are seen more and more to correspond with those of our fellow-men. That such correspondence is possible, is due to the nature of the intellectual life which is shared by all men in common.

CHAPTER IV.

THE GROWTH OF KNOWLEDGE.

§ 11. The Vital Feature of Knowledge.—The idea of construction which occupied us in the last chapter is so far helpful in enabling us to understand the general nature of knowledge. That view alone, however, fails to do justice to another very important feature, namely, that one's knowledge can never be regarded as complete at any time, that if we were able to make a cross-section of it at any given place or point of time we should see at once that it is simply a stage on the way to something else.

There is a continuous process of construction and reconstruction going on in our knowledge. A house, (tool, weapon, machine, any object demanding constructive skill), may be conceived, the materials for it procured, prepared and adjusted, and the whole structure completed once for all. It stands in the form given to it by the labour, mental and physical, bestowed upon it by the builder, and is the same house or what not to all intents and purposes for ten, fifty, or one hundred years to come. But knowledge is not of this character. We are not to think of it as a whole composed of parts which are once for all put together in a mechanical way as a joiner might assemble the various parts of a house. Thought is not a lifeless thing put together part by part. The relation which one portion of our knowledge bears

to other portions is not a fixed and final relation. On the contrary there goes on in knowledge a continual shifting and re-arrangement of the facts of our experience. New connections, new combinations, new views constantly come into existence.

The process of building up knowledge then is not to be regarded as mechanical, but rather as vital. Knowledge grows; and this way of looking at the matter will be found to be much more helpful than the mere idea of construction, which is only one side of the matter. Let us consider, briefly, the chief difference between the result of a mechanical process of adding part to part, such as a house, a bridge, or a bicycle, and the result of a vital process of growth as seen in a plant, or an animal. The term organic is used in connection with the latter, and this term marks the difference we desire to emphasize. In an organization such as a plant, the relation of part to part is much more intimate than in such a product as a house. In the latter case you have each part serving a special purpose in subordination to the larger purpose which guides the whole construction and determines its character. The parts of a plant, on the other hand, are mutually related to each other both as ends and means; they are members rather than parts; and its character as an *organism* is determined by this relationship.

§12. Organic Growth.—Now it is obvious that if we can examine any given organism at different stages of

its growth, noting in each case the relation existing between its parts or members, we shall be able to form a pretty correct notion of its real nature. This is true not only of living organisms, but also of the history of the products of human art and contrivance.

It is usual to refer, for illustration of the laws of growth, to the amœba, an organism very low in the scale of life; and to examine it alongside of some other animal considerably higher in the scale, such as a vertebrate. There are several important respects in which these two types differ. The earlier type is almost structureless; it is simply a little bit of protoplasm, nearly of one kind throughout; and whatever it does in the course of its life can be done by any one part of it as well as by any other. The later type, on the other hand, is composed of a great many parts; each part (or member) having its own special work to do. And we observe also that along with the greater degree of complexity in the later, there also appears a greater degree of dependence among the members. The parts of a vertebrate, in so far as they have a special function to perform, are essential to the well-being of all.

In the amœba, on the other hand, as there are no special organs and no division of labour, so there is the least possible bond of connection between the parts, no one part being particularly necessary to the creature's existence.

We may compare in like manner a social type of an early stage of development with another of a later stage. The tribe or clan presents a comparatively simple structure. It is an aggregation of families each of which is engaged in the task of getting a living in pretty much the same way as every other. The principle of division of labour appears, it is true, but only in a very slight way at first. Each man is at once husbandman, fisherman, hunter, trader, warrior, and perhaps legislator. In a nation, by contrast, you have much division of labour, each man or group of men in the very complex organization performing a certain special kind of work. Here, also, we can clearly see the necessary connection between complexity of structure and interdependence of the members. A loss in war of one-tenth of a clan or tribe is simply a quantitative loss, so to speak. Where every one can turn his hand to anything the life of the whole organism will go on much the same as before. Not so in the case of a modern society. A proportionate numerical loss of individuals would produce most serious effects upon every part of the nation's life.

In the productions of human art, as well as in the case of living organisms, we may find numberless illustrations of the laws of growth. The dug-out is at one end of the scale, the ocean liner at the other. There is extreme simplicity of structure in the one case, extreme complexity in the other. And with the growth in complexity as we pass in view before us the intervening types of

vessel we observe a corresponding increase in the degree of interdependence of the parts. The candle and the electric light, the log shanty and the modern dwelling house, primitive and modern weapons of warfare—all of these may serve to illustrate the same process of growth.

§13. **Organized Knowledge.**—"Evolution, then, not only exhibits a constant process of differentiation, and a constant increase in the diversity of parts and organs, but there goes along with this what might be called a process of unification, whereby the parts are brought into ever closer and more essential relation to one another."[1] There are thus two features or aspects which are common to all cases of growth. The terms generally applied are *differentiation* and *integration*, the former referring to the gradual growth of parts with special functions to perform, the latter emphasizing the corresponding growth in the interdependence of the parts which go to make up the organic whole.

In order to see in the growth of knowledge another illustration of this law, it is only necessary to compare the knowledge of the child with that of the adult. In the first place we observe at once the obvious fact of the greater complexity which characterizes the latter; and secondly, the organized and systematic thinking of the adult stands out in clear contrast with the fragmentary knowledge of the child. We have here the two phases

[1] Creighton, Op. cit., Ch. xx, § 72. What follows in this paragraph is a restatement of Professor Creighton's application of the general law of evolution to the development of the thinking process.

or moments of our law of growth. Increase of knowledge involves differentiation or discrimination, the power to make distinctions, to distinguish between this and that. *Analysis* is the name usually given to this feature of the process. It involves also unification or integration, that is the relation or connection of the various parts of one's knowledge. We discriminate in order to relate, and this phase of the total process is known by the name of *synthesis*.

In order to realize the difference between the mind of a child and that of an adult we may try to picture the contents of each as a whole. Speaking broadly, what characterizes the former is that while a great many items of knowledge are stored up, there is no very great degree of relation between these separate items. On the other hand, the adult not only possesses a greater aggregate of knowledge, but also has put it together, has connected the various parts one with another. This interconnection of the parts or portions of the contents of the mind is just what the educated adult has accomplished, and what the child or the educated person has, so far, failed to accomplish.

The presence of these connecting links in the one type and their absence in the other type may be seen not only in the contents of the mind, taken as a whole, but also by reference to any single item of knowledge. The child knows, for example, a good many things about the domestic animals around him. He notices that

certain of his favourite pets are fed upon certain kinds of food, while others require something different to live upon. He has also observed a number of interesting facts in connection with the appearance, shape, structure, and habits of these animals. But these various bits of knowledge may simply lie alongside of each other in his mind for a considerable time before any necessary relation or connection is established between them. The adult knows more facts than the child does, but that is not the chief point. What we are calling attention to here is that there is established in the mind of the adult a relation or set of relations between the physical structure of the animal in question and the food he eats.

The child, to take another instance, is quite well acquainted with some of the physical properties of gold and silver; and he also knows something of the uses of money. These items of knowledge may remain in his mind in a quite isolated fashion for a considerable time. After a certain stage of development has been reached he may come to recognize that there is some kind of relation between the properties of these metals and the use to which they are put. The system of ideas suggested by the word 'gold' and that suggested by the word 'money' have come into close relation to each other. They are now linked together; whereas in his earlier mental life they lay quite apart.

Almost everyone will recall instances in his own experience where he was able to detect himself in the

very act of discovering a previously hidden bond of connection between two or more facts or groups of facts. A child may be able to recognize and distinguish the objects about him, and also to associate with them certain names which for him possess no significance beyond that of identifying the objects. The adult on the other hand has learned something of the history of the words themselves, and so attaches a special significance to them, thus establishing systematic connections in thought which are absent from the mind of the child. An extreme and amusing instance of this is seen in the story of the man who had been using a dipper for various purposes at intervals all his life and who suddenly exclaimed one day,—"It never occurred to me till this moment that this thing is called a dipper because you can dip with it." That the English at one stage in their history suffered severely from a dreadful pestilence known as the Black Death, and that shortly afterwards there was a marked decline in agriculture and a marked increase in the production and export of wool are items of information that a schoolboy may read in a history of that period, without enquiring into the question of a possible link of connection between the two facts. An adult might supply a link in the fact that extreme scarcity of labour renders it difficult or impossible to till the fields, whereas very few herders can look after a great many sheep. Again, the same schoolboy might know as a fact by itself that there was

in the time of the Edwards and later a Scotch-French alliance, and as another and separate fact that about the same time there was an English-Flemish alliance. Later on in his mental experience he may be able to connect these facts, not only as phases of the political antagonisms of the time but also as features of a peculiar industrial and commercial situation.

These examples will, perhaps, serve to show that increase of knowledge is something more than a mere mechanical addition or aggregation of part to part. Fragmentary knowledge is characteristic of the undeveloped, while systematic, organized knowledge is characteristic of the developed mind.

The object we have in view in thus considering knowledge from the standpoint of growth has already been stated. We desire to get a clearer idea of its nature. In order to do so, we have noted the relation existing between the various portions of an individual's knowledge at different periods of growth. We have seen that advancement in intelligence means organization into a systematic whole of each bit of knowledge that we possess. The extent to which order and relation have been introduced among our ideas marks the stage of development we have reached. In a complete system of knowledge there would be nothing fragmentary, nothing isolated; every part would be related to every other part.

Summary.—We can supplement our idea of construction in knowledge by investing it with the further idea of growth. The process of knowledge-getting is vital rather than mechanical,—one of inner development rather than external addition of part to part. This growth of organic knowledge involves differentiation and integration (analysis and synthesis); and this means not merely a greater mass of facts, but also, and chiefly, the orderly arrangement of facts in systematic connection.

PART II.—JUDGMENT AND INFERENCE.

CHAPTER V.

JUDGMENT AS THE FUNDAMENTAL FEATURE OF ALL THINKING.

§ 14. Thinking Processes, Simple and Complex.— Our study of the growth of knowledge in the last chapter has brought out the difference to be observed in the mental possessions of the individual at various stages of his experience. Let us consider now the nature of the element or feature which belongs to the thinking process as its distinctive mark or character, present at every stage of the process.

What we have seen of the growth of other organisms suggests to us that there must be some peculiar feature in the thinking process which possesses the same character throughout. We have seen that the difference between the earlier and the later types which we examined was a difference of complexity only. The modern self-binder is only a much more complex machine than the old-fashioned reaper. The ocean liner stands in a similar relation to the dug-out. So with the vertebrate and the amœba. The later type of product, or of living organism, is one in kind with the earlier. The function of the binder, like that of the reaper, is to cut grain. Ocean liner and dug-out share the common purpose of carrying freight and passengers on the water. The vital

functions performed by the vertebrate are performed by the primitive cell.

So with the differences which have been noted between the earlier and later types of thinking. They are merely differences in complexity. The earlier and later types are, at bottom, the same. What is the nature of this element or feature which is common to every mental act by which our knowledge is increased? In order to answer this question, it will be necessary to recall what has been said in the preceding pages regarding the nature of knowledge in general; for if all the functions of the fully-developed organisms of the biologists are really and efficiently performed by the earlier or earliest ones, then we may fairly expect to find that what is true of knowledge in general is true of the simplest type of thinking. It was stated that thinking, or getting knowledge, is an effort, or series of efforts, of interpretation; that the mind is not a mere passive receptacle for ready-made facts, but is essentially active and constructive; that this activity is simply a means to an end, the end in view being ever a practical one; and finally that knowledge is not only an active and conscious process, but also a vital process—one of development or growth.

If our course of investigation has been the right one, we shall find these features present in the characteristic mental act which bears the same relation to knowledge in general as does the original cell of the biologists to animal life in all its various forms.

§ 15. **The Judgment.**—We find these qualities, properties or functions in the process known as judgment. Judgment finds adequate expression in the sentence or proposition. And just here it is, perhaps, desirable to direct attention to the fact that the judgment and the proposition are very closely related to and yet quite distinct from each other. Whatever the relation is which connects thought with expression in general the same relation is to be found or at any rate sought here. We say that language *grows out of* thought, that thought is *clothed* in language, that language is a *vehicle*, and the like. These and similar attempts to set forth the nature of the relation between thought and language serve at any rate to show that this relation is a very intimate one. Nevertheless, the judgment is one thing and the proposition is another. Or, perhaps, we had better say that judgments are thoughts and propositions are things.

(*1*) *An Act of Interpretation.*—Every act of judgment whether simple or complex is an attempt to interpret some portion of our experience. In order to realize this it is only necessary to examine any ordinary, every-day judgment. On observing a patch of colour on the horizon in the evening, one says "that is the moon rising." What has taken place in the mind may be briefly told. There is first the appearance of the red or yellow spot low down in the sky. The interval between our becoming aware of the red spot and uttering the statement is taken up with the work of the mind in

judgment. There are several things to be considered, the hour of the day, the general condition of the sky as related to the colour of the object before us, the direction in which we are looking, etc. In the instance under consideration there is of course the probability of mistake. Is this a prairie fire, or a burning stack? If such questions arise final judgment is delayed. In any case the sensations themselves are nothing more than just so much data upon which the mind has to work. The meaning of what is before us is sought for, and when that meaning is clear to us it may be set forth in the form of a proposition. In other words, the mind has been engaged in the work of interpretation.

(2) *Of Construction.*—The constructive activity which we spoke of in § 8 is seen in each single act of judgment. In the illustration just given you have to put this with that, and so build your facts together within a coherent system as to enable you to reach the conclusion with confidence. Knowledge is systematic: we can interpret only in so far as we are able to construct; and this is true of each step in interpretation.[1]

(3) *Of Valuation.*—In the case before us the individual judging would not take the trouble to decide the matter at all unless impelled thereto by some practical interest. What is true of the getting of knowledge generally in this respect is true of each act of judgment. The man who finds himself quite uninterested in the

[1] See Creighton, Op. cit., Ch. xx, § 73.

state of the sky on a given evening, or to whom a prairie fire or the destruction of his neighbour's property is a matter of no consequence, will hardly take the trouble to form a judgment under the circumstances. It is to be noted that even the casual remark "that is the moon rising" is a real judgment, whether made on adequate grounds or not, for in such a judgment it would not be difficult to discover the purposive element. Indeed the mere act of naming a thing is a judgment. To see the practical side of such judgments it is only necessary to enquire why we give names to a thing, what we want with a set of signs.[1] The meaning of any term taken at random has to be explained finally, as we have seen already, by reference to some use or purpose. Judgment is always a process of valuation.

(4) Exhibiting Growth.—Finally, we may see by reference to the example at hand that the activity of judging is a living, as well as a conscious process. The judgment "that is the moon rising," when made in an ordinary way may, if the possibility of a mistake be suggested, grow into inference. It becomes inference just as soon as the speaker reaches a consciousness of a ground for his assertion. Within this judgment then we see a process of development going forward with the result that what is at first a simple act of judgment has expanded and grown into a more complex act, a fully developed judgment.

[1]See Bosanquet's Logic, Vol. I, p. 23.

Summary.—Judgment, then, is properly regarded as the fundamental and characteristic type of thought. All knowledge begins with judgment, and without it there is none. Every addition to our knowledge is by the exercise of this power. Judgment is at work from the very beginning, and may be detected in the first feeble glimmerings of conscious life, as well as in the highest achievements of scientific genius. Knowledge is the result of a continuous process of judgment. "All knowledge," it has been said, "is judgment in the sense of an affirmative assertion."

CHAPTER VI.

THE NATURE OF JUDGMENT.

§ 16. The Systematic Necessity of Judgment.—A little reflection upon the ordinary course of our experience shows us that every judgment is made within a system.[1] We have already seen that the number of systems within the scope of one's knowledge is simply countless. Some of these are highly complex, others less so. Concrete objects form a considerable proportion of the systems in the minds of young children. As time passes the number of non-spatial systems increases. In earlier as well as in later life, however, the knowledge which we acquire is at each step related to what we already know. A judgment completely isolated from the rest of one's knowledge would be an impossibility for anyone, no matter how great or how small his previous stock of ideas. The getting of knowledge requires the activity of judging. In judgment we relate this to that, or in other words we are engaged in the systematic construction of our experience.

In order, therefore, to understand clearly the distinctive features of judgment it will be necessary to keep in mind the concept of system from which we started, that is, "a whole composed of parts so related

[1] "All judgment whatever is within a real system"—Bosanquet, Logic, Vol. I, Chap. ix, p. 389.

to each other, so held together by a common nature, that you can tell from some of them what the others must be."

Now it is evident that the important part of this definition is that which calls attention to the way in which the parts are connected to form the whole system.

If this feature of connectedness or relativity were absent we should have, not a system, but a mere aggregate. In an aggregate the parts simply lie alongside each other in a purely external relation, in such a way that addition or subtraction does not alter the nature of the whole; and hence there is no unity and no real connection. In a system, on the other hand, the parts stand in a certain relation to each other; and it is this relation which enables us to say with confidence:—"Given *this*, as part of a system with which we are acquainted, we are entitled to state that *that* and *that* are other parts."

For convenience the term "Ground" has been employed to indicate this "relativity within a system" of which we are now speaking: and one of the chief features of judgment is that every judgment has a Ground.

Thus, when the trapper affirms that "this is a track of a fox" he does so upon a certain ground. He is judging within a system. That system includes what he knows of the shape, weight, and size of the animal spoken of, and of his habits of life in general. The way in which

the various parts of this complex system are connected, what we called the relativity within the system, or the *Ground*, is just what enables him to say with confidence, "This mark in the snow has been made by the foot of an animal of such a shape, size, weight, and habits." And at this point we may note not only that the trapper is entitled to utter his judgment with confidence; but also that it is manifestly impossible for him to come to any other conclusion. He comes to that particular conclusion, not because he deliberately chooses to do so, but because he cannot come to any other.

We often say, "I am forced to the conclusion that so and so is the case." The *Ground*, that is, as we have just said, the way in which the parts are related in the system within which we are judging, compels us to state results or conclusions which may indeed in certain cases be unwelcome. For the reason, then, that we judge not as we wish, but as we must, judgment is said to be *necessary*.

We may readily verify the existence of this feature of judgment by reference to any statement of ordinary intercourse. As another illustration take the following: In the evening a patch of bright colour appears on the floor near the window, and someone says, "The sun is shining in at the window." But the day has been cloudy and the statement might be challenged. To assure one's self there are certain related matters which would naturally be considered. The time of the day and of the year,

and the position of the window in reference to the evening sun are related facts within the system to which one is likely to appeal on the instant. The way these facts are connected within the system, their relation to one another, constitutes the ground for our judgment, justifies us in making it. But the ground not only justifies us in making that judgment. It seems to do more than that. It practically forces us to judge in that way. We feel that we have no choice in the matter. We know that we are unable to reach any other judgment than just that one and no other. Certainly we could refuse to utter the sentence at all, or we could go further and utter a falsehood if we wished to do so. But our real judgment would remain the same. We should be compelled to say within ourselves: "The sun is shining in at the window."

Now it is specially to be observed that this search for a ground, for a necessary connection among certain facts, does not take place on all occasions. The great majority of our judgments are formed and uttered with confidence and pass unchallenged. There is no doubt in our minds about them and there is none in the mind of anybody else. We say, "There goes the noon gun," or "That is the postman," without giving a thought to the ground upon which our statements rest. Nevertheless, although we do not at the moment *take time to exhibit the connection* of facts within a system, we find ourselves at the same time under the necessity of judging as we have done under the circumstances.

This *felt necessity* of judging is just as real and just as steadily operative in the class of cases mentioned as the *conscious necessity* in that other class of cases where doubt has arisen and where we deliberately set ourselves to work to *show* how our facts are connected in a system. There are, of course, certain instances where it is somewhat difficult to exhibit this necessary connection of facts. "An uneducated man or a child, if his perception or his memory is doubted, will sometimes merely reiterate his assertion." There has been, we may suppose, an effort and failure in such a case to get beyond the assertion and a return to the original statement which is intended to convey the fact of the speaker's absolute "inability to think otherwise," or in other words the felt necessity under which the particular judgment is formed. "An educated man makes a similar justification explicit when he tells us that he relies on the evidence of his senses. The phrase is, perhaps, primarily intended to be ironical, as implying that the senses give the fact and not mere evidence of the fact, but its irony fails, because it is strictly true. Sense .... cannot give the fact, and is strictly, as the supposed speaker called it, evidence, circumstantial evidence or datum."[1]

The necessity of judgment, then, whether felt or conscious, is a property which is due to the existence of a ground upon which the judgment rests. This may be

[1] Bosanquet, Logic, Book II, Chap. i, p. 17.

otherwise expressed by saying that judgments are mediately, not immediately necessary; that is to say, the necessity belongs not to the judgment itself but to its connection or relation with other judgments.

§ 17. The Truth, or Universality of Judgment.—The term universality is usually employed to mark out another property of judgment closely related to the one just mentioned. Upon the basis of the necessity of judgment, felt or conscious, of which we have spoken, our judgments claim to be true for every one. "To present a statement which is true and calls for belief" is declared by Sigwart to be the very "essence of judgment."

The presence of this quality of universality distinguishes the judgment from the mere concept or idea. Ideas frequently present themselves and succeed one another, as mental occurrences merely, without being asserted to belong to the real world.[1] If you say to your companion, "The new railway——" and stop there, it is true that he will probably begin to form provisional anticipatory judgments during the pause.

[1] The logical difference between such forms as the "the white horse" and "the horse is white" comes out here. There is probably no difference between the mental images involved. The former group of words it is true may be uttered as the result or expression of a judgment. It may mean of course—"There is the white horse" or "See the white horse," or it may be the answer to a question. In such cases we have a judgment just as truly as when our words take the form "The horse is white." What is actually meant in any given case is easily determined by reference to the tone of the speaker or the context.

On the other hand where the words "The white horse" stand out as the adequate expression of what is in the mind unaided by any modifying tone or context there is no claim to truth made by anyone upon anyone else. When the words are "the horse is white" there is such a claim made upon the belief of all who hear.

But if you have not got any further on in your mind than is indicated by your words you have not judged; that is to say, you have not made any claim upon anyone's belief.

Further, if you should say "The new railway runs through a prosperous country," knowing all the while that it does not do so, your mental act thus misrepresented is first of all the judgment, "The new railway does not run through a prosperous country," and next the determination to affirm the contrary. Your judgment in the circumstances may be true or it may be false, but you cannot judge what you believe to be false. Whatever you judge, that you believe to be true. We have seen in the last paragraph what there is to support your belief in the truth of what is uttered. There is a ground, a certain necessary connection between the ideas now affirmed as true and other ideas within a system,—a ground which not only warrants you in reaching the conclusion but which also obliges you to think in that particular way.

Very frequently there are serious differences of opinion about matters even of ordinary sense perception, but all the communication we have with one another assumes that agreement can be reached in regard to what is true. The very fact of a difference of opinion and an effort made to overcome it points to the possibility of agreement upon what is called "objective" truth.

The logicians usually dwell upon the obvious fact that

only judgment can be true or false, and that we cannot apply the terms true and false to things themselves, but only to our judgments concerning them. Thus a counterfeit coin, or a piece of wood painted to look like iron, or a man who personates another, is spoken of as false; not because these are not real things but because they pretend to be something which they are not; to places within systems to which they do not belong.

§ 18. Judgment as Instrumental.—In the every day affairs of life there are countless incentives and irritants which call for action. Every situation thus created has its own specific problem. It is towards the solution of such problems that the activity of judgment is directed; and in the aim or end in view in typical cases we may learn something of the nature of that activity.

Ultimately, without doubt, our judging activity is brought into play by the practical interests of life. Some have thought that if our inherited motor reactions were sufficient for the task of adjusting the organism to its environment there would be no necessity for, and no likelihood of, the appearance of consciousness at all. As it is, however, we are continually setting ourselves to this task of adjustment, a problem which can be reduced in all cases to the form: "what is to be done under the circumstances"?

Now a full account of the activity of judging should answer such questions as would naturally be asked regarding the use of any instrument. The

circumstances which call for its employment; the use or various uses to which it can be put; the method of its effective use; the form in which the results appear,—these are questions which may fairly be asked regarding the activity of judgment as instrumental. An attempt will now be made to furnish an answer to each of them.

(1) *The occasion.*—It has already been pointed out with some fulness of detail that it is when circumstances arise which call for new adjustments that the individual sets himself to "find out things," to investigate, to get knowledge. The accomplishment of an end of some kind,—the attainment of some good,—it is to this that judgment is incidental every time it occurs. If you wish to go on a journey you are likely to ask and get answers to questions regarding your route of travel, your conveyance, the condition of the roads and of the weather. Here we have an example of a condition or set of circumstances which calls forth the activity of judgment, an activity which involves a process of valuation incidental to the carrying out of a purpose.

(2) *The use of the instrument.*—This may be made clear by saying that the judgment is engaged in the work of reconstructing experience. Mental life is continuous, and what we have been and have done determines our method of solving practical difficulties as they arise in the course of our efforts to accomplish any given end. The reconstructive function of judgment

comes out strongly in those cases where physical reconstruction of materials is necessary to the accomplishment of a purpose, as for example where the boy sees in the small sapling the fishing rod he has been wanting. "There is my fishing rod," must of course have preceded the actual work of cutting and trimming it. Here is a homely case of a deliberate reconstruction of experience. Under pressure of some other need a different reconstruction might have been made. The boy's previous experience was such as to enable him to judge as he did and thus "reconstruct his experience."

But reconstructive work is as truly performed through the instrumentality of judgment at every stage of experience. It will be seen to be operative in any judgment taken at random. "That is the noon gun." "These flowers are of such an order." "My watch is slow." "Balfour has resigned the government." In these cases we can readily see this reconstructive activity operating in different phases of our experience.

Such reconstruction being undertaken in the interest of the individual judging, every judgment is necessarily a process of valuation. Only in this way can our judgments be satisfactorily interpreted. "The only concrete object ever actually known or in any wise experienced," indeed, one may say, the world of concrete objects as any individual knows it is a world "constructed by that person in accordance with his own aims and purposes,

and in which there is, therefore, a large and important share of meaning which is significant to no one else."[1] Valuation is a process which can be seen to belong just as truly to the realm of sense perception as it perhaps more obviously does to that of natural science and ethics.

(3) *The method of using it.*—Judgment is at once analytic and synthetic in its mode of operation. This analysis and synthesis must not be confused with the physical process of breaking up into parts and putting the parts together again. As a result of the mental process we are enabled to think in the case, say, of a concrete object, now of one or other of the parts of the whole, and again of the relation which each part bears to the whole. A physical process of taking things apart is one thing, and putting them together is another thing. We are, therefore, apt to think of the mental process as either beginning with a whole that is given as a whole, or beginning with the parts given in their isolation as such.

Things are not "given" to us, however, in any such way. Mental life, as has been said, is continuous, and the matter concerning which we judge is always relative to some problem awaiting solution. There is the inner need, and the unassimilated though not absolutely unknown "material" to be worked over. It is clear that what is before the mind is a complex, recognized as such,

[1] Dewey. –Studies in Logical Theory, p. 229.

and that to accomplish our purpose fully its elements must be distinguished and related.

"The plain is covered with snow." This judgment may be made with reference to one's aesthetic interests. It is clear that the aesthetic valuation of what is presented by sense perception involves the selection of certain features not as held apart from everything else but as related to a system of values. There is selection for the purpose of relation.

We have to answer the question: How, in what manner, does the judgment in its process of valuation perform its constructive work? What, in other words, is the chief feature of the process of building up a system to which reference has been so often made.

We must bear in mind that judgment always works within a system. In order to see clearly the method of its operation let us recall the nature of system. It is a whole of parts related to each other in a certain way. Now, whether we take the point of view of construction or the point of view of growth we recognize that any addition to our knowledge within a given system must involve a change from a simpler to a more complex form. If one says "the climate is hard on people with weak lungs"; and if this judgment is a real one, that is, if the speaker has really added to his stock of knowledge and is not merely repeating words, there has been a change in the system which corresponds with the phrase, "this climate." To what he already knew about it has been

added this new feature or item, and the new feature or item has in its turn in entering into the system modified to a greater or less degree the "relativity" of the parts within.

Summary.—Every judgment is said to be necessary. It possesses this quality of necessity in virtue of its function of systematic construction of experience. Relativity of parts is the mark of a system; and upon this relativity or ground our judgments rest, and by this relativity our judgments are *necessarily* determined. Our judgments *claim truth*, a quality which they possess as a consequence of the former quality of necessity and which distinguishes them from mere floating ideas or concepts. Judgment is the instrument we employ whenever a practical problem confronts us. Under pressure of our needs we proceed to a *reconstruction* and *revaluation* of the facts of life, and this reconstruction of our systems of knowledge goes forward by a double process of *analysis* and *synthesis*.

CHAPTER VII.

TYPES OF JUDGMENT.

§19. The Categorical Judgment.—It has been said that we never seek knowledge except to satisfy an interest, that our efforts in getting knowledge are always determined by some practical end.

We have already considered the idea of living organisms undergoing a process of continuous growth. There is on the one hand the organism itself with a certain character of its own, and on the other hand a certain set of conditions. There is a continual activity on the part of the organism with its own well-being in view. It seeks to adjust itself to changing conditions. Every new situation demands a response of some kind.

This suggests again the true function of judgment. The work of interpretation is carried on through the instrumentality of judgment; it is the tool or instrument employed to guide us in our efforts to act rightly in the presence of any given situation. What this situation means, that is to say, what it demands of us in the way of action, is the problem to be solved, and our success in solving it depends directly upon the degree of skill we have attained in the employment of the instrument.

With this idea of the instrumental value and function of judgment before us let us look next at the principal stages in the development of judgment. We shall have

to bear in mind, however, that there is no distinct line to be drawn between the types; but that they shade into each other by close gradations.

We are naturally led to examine first of all those judgments through which we attempt to place a value upon our experience in sense-perception. What we observe of actual sounds, colours, tastes and the like, and what we find in our memories of what we have actually come into physical contact with cannot but constitute a very large part of the material upon which our judgment does its work.

We have seen that in our efforts to interpret the world about us we are not satisfied until we have succeeded in giving to the thing which we are trying to interpret or explain a place within a system. That is the end we aim at. We shall not, therefore, look for a complete and thoroughly organized system of thought as long as we remain at the stage of sense-perception. Systems we shall have, no doubt, but, as we have seen, the earliest thinking does not exhibit more than a *tendency towards* that ideal which has been pointed out in an early chapter. In contrasting the contents of the mind of an adult with that of a child we saw that the chief difference was not one of quantity but of relation or connection; that a certain coherence or relativity or connectedness was prominent in the one case and notably lacking in the other. Relatively few systematic connections, we saw, mark the mental possessions of the young child and the

savage. In other words, the world is in the earlier stages of our experience little more than an aggregate or "sum of things." The systems formed are chiefly of the spatial order. The business of life seems to be first to distinguish things *from* each other, rather than to discover the relations in which they stand *to* each other. We may regard as a fairly well marked class of judgments those which we reach while engaged with the concrete particulars of our present and past perceptive experiences.

But new interests arise and new points of view; and we may, without serious strain upon the metaphor adopted, imagine an improvement in the efficiency of our instrument, greater skill and accuracy in its employment, and finer products as a result. The tongue, we are told, is the only edged tool that grows sharper by constant use. However this may be, we can be fairly sure that much exercise of the function of judgment in a given department is the condition which alone ensures the growth of power to judge within that range. The advance toward system seems to be by way of attempted answers to the question, "Why?" You may be quite convinced that so and so is the case, and be prepared to act upon your belief without enquiring any further into the matter. But a distinct step forward is involved in the effort to maintain one's view of the case in answer to doubt or enquiry.

Let us suppose the categorical statement "That is a prairie fire" to be questioned, and alternative predicates suggested,—"That is a burning straw stack," or "That is the moon rising." We have here three different attempts to solve the problem, and the acceptance of one hypothesis involves the rejection of the others.[1]

§20. **The Hypothetical Judgment.**—One assertion is just as good as another so long as we simply put it forward without any attempt to show the grounds on which it rests. Once the attempt is made a new feature is introduced into our thought; a distinct advance has been made; and a new type of judgment emerges. Every predicate is a more or less completely developed hypothesis. The patch of colour on the clouds is to be explained by giving it an appropriate place within a system. One suggests as hypothesis the following:—"In the fall of the year the grass is usually long and dry. The past summer has been wet and the grass is long. There has been a severe frost. The grass is, therefore, dried, and there has been no rain lately. It has been a windy day. A considerable portion of the sky is illuminated. There is a large area of prairie grass in that direction." These are the principal related items in the system, and with knowledge of the ground, or the way in which these items are related, we judge, thus and so.

[1] "The hypothesis of the investigator differs from the comparatively rough conjecture of the plain man only in its greater precision. Indeed, as we have attempted to show, the hypothesis is not a method which we may employ or not as we choose; on the contrary, as predicate of the judgment it is present in a more or less explicit form if we judge at all." Dewey, Studies in Logical Theory, p. 182.

The development which our judgment has thus undergone can be exhibited in a statement embodying in brief form the relation which the matter to be explained bears to the whole ideally constructed system. Instead of the categorical judgment "That is a prairie fire," we have: *Given* certain conditions, prairie grass, dry weather, fall of the year, careless traveller, red sky, etc.; *then* prairie fire. Briefly, we may say, that when we have such a knowledge of the system involved as will enable us to show the relativity of parts within it our judgment has developed from a lower and simpler to a relatively higher and more complex type. We are no longer dealing with "things" in isolation from each other, as mere particulars. We have made an attempt to judge regarding the way in which things are necessarily connected.

§21. **The Disjunctive Judgment.**—All of this points to a further development. In a system there is a whole of parts so related to each other that you can judge from some of them what the others must be. At the stage we have just been considering our knowledge of the system is greater than at the stage preceding. Our acquaintance with the system enables us to consider the relation of the parts to each other and so to proceed securely to a definite conclusion on the basis of this relation. But we are still some distance from a complete knowledge of the system.

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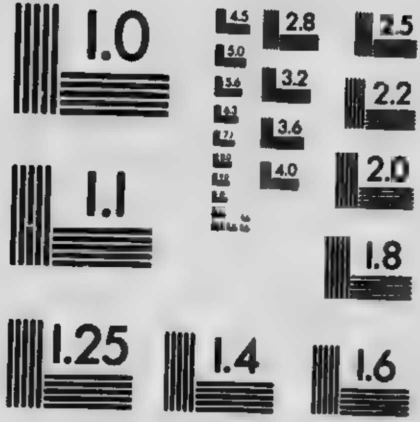

Let us try to trace this process of growth a little further. It is a step forward to be able to say that such and such are parts within a given whole. Thus one might say on seeing the name Calgary on one of the parts of a dissected map: "That is part of the map of Canada." It is a distinct advance upon this when we can say of one of the parts: "If Calgary is on the Bow River, this block goes to the right of that." In order to be able to form a judgment like the latter our knowledge of the system is such as to warrant us in saying that this or that part stands in a certain necessary relation to others. Given this, that follows. A very slight knowledge of the system (Canada) is all that is necessary to the formation of the first mentioned judgment, which is clearly categorical. In this latter case, however, there is required an insight into the way in which the parts, or some of them, are related to each other. Apart from such ground we should not be able to form the judgment spoken of; quite as clearly an hypothetical one.

The emphasis of our thought here is upon the relation of the parts to each other within the system. When that emphasis is transferred from the relation of the parts to the organic unity, the individuality of the whole system, we have reached a still higher stage of knowledge.

Our judgment will of course depend on the purpose we have in view. We may think of the map as

representing a system of political units, as a system of mountains, valleys, plains, lakes and rivers, or as a system of industrial and commercial relations and the like. In any case the emphasis will be upon the way in which the parts or elements, or members, go together to form an organic whole.[1]

The aim of judgment at this latest stage is to give a full account of the system in its internal relations, *i.e.*, as an individuality. It aims to set forth, at once, the system and all the connections within it. To do this within the limits of a single proposition is not easy; we must have recourse to some compendious form. "A given town or other political unit, A, is either in one of the provinces or in one of the territories" Our knowledge of the system thus affords us a strongly advantageous starting point. At first sight we may seem to have admitted that we know little or nothing about the matter in hand. But a little reflection shows that this proposition is an "attempt on the part of intelligence to determine the whole series of circumstances, a condition within which any fact of perception may fall, and to state the conditions in such a way that their relations are at once evident."[2] If A does not fall within one of the territories, the above proposition informs us, then it must be in one of the provinces.

[1] In an organism each part receives its character from the relation to the individual (or indivisible) whole, the parts being mutually related to each other both as ends and [illegible]

[2] Creighton, Introd. Logic, p. 146.

Further determination of the problem is possible by following the same course. A is either in Old Canada, or in the Prairie Provinces, or in British Columbia. The form in which judgments of this type usually appear is, as indicated in the example we have been considering: "either....or...."

It is well to emphasize the fact that the three great types which we have been considering correspond to as many well marked stages in individual development.[1] The discovery of universal and necessary relations among phenomena seems naturally to belong to a later period than the acquisition of knowledge about phenomena in comparative isolation from each other. Long before we have discovered why events occur in a certain order, we are aware that they do so occur. At a comparatively early period it may be well known that certain roots or berries are to be found in a certain locality. It is not until considerable progress has been made in knowledge that it is known that plants of that kind flourish under certain conditions of air, soil, and moisture.

In the first instance you have the single fact pointed out "These berries grow in such a place," a categorical

[1] These three stages in the growth of knowledge have been well described by Professor Welton, (The Logical Bases of Education, Chapter I) as (*a*) explanation of the world as a Sum of things, (*b*) explanation of the world by Laws, and (*c*) explanation of the world as System. At first man "regards the world as a sum of things whose relations with each other are accidental. From this point of view 'things' are units of existence which can be re-arranged in any way like a set of ninepins or a group of billiard balls without altering their nature...... Modern science began with the discovery that the nature of things is affected by their relations. And this discovery was the necessary result of a deeper study of the things themselves. Even to a superficial observation it was evident that many things change according to the relations in which they are placed."

judgment. The later movement of thought is hypothetical: "If berries are found there, *then* the air, soil, moisture and other features of the locality are of a certain definite character." And further, when the purpose we have in view in seeking knowledge of these facts and their necessary relation to each other has been so fully realized as to warrant us in saying, "This plant, A, belongs either to the B or the G variety," we have advanced to that stage of thought which has been characterized as systematic, in a distinctive sense, and our judgment here assumes the disjunctive form.

§ 22. **Difficulties of Classification.**—We have already noticed that "types" do not stand apart from eac[illegible]her separate and distinct, but shade into each other by small differences. In a large number of cases the "type" is strongly marked. The **Categorical**, the simple judgment of fact which tells us nothing more of a system than that a certain fact belongs within it, may be illustrated by the following: *[illegible] is a tall man. The sky is blue. The roads are roug[illegible]. Many stars are shining. Many fell by the sword. Caesar conquered Gaul.* In these the reference to reality is direct.

The **Hypothetical** gives us a fuller insight into the nature of the system within which the judgment is made: *If this triangle is isosceles, it has two equal angles. If you multiply 8 by 6, the result is 48. If the Education Bill contains such and such provisions it will be rejected by the House of Lords. If the train is on*

time we shall reach the coast Tuesday night. If that plant is of such and such an order the leaves will be of such a shape. In these we lay stress upon the necessary connection of the parts of a system, the reference to things or objects being indirect.

The **Disjunctive** judgment takes a form which completely exhibits the contents of a system. *A triangle is right-angled, acute-angled or obtuse-angled. Either the wicked will be punished or there is no divine justice. All numbers are either prime or capable of being analyzed into factors. You shall either go or hang.* Not only is the system fully expressed, but the special features of the two earlier types are to be seen here. A is either B or C. From this we are entitled to form several hypotheticals: If A is B it is not C; If A is not B it is C, etc. And the conclusion, (for example, that A is B) is categorical and the reference to reality is direct.

But it is not always possible to distinguish categorical and hypothetical propositions by the *form* in which they appear. We must look further in and ask for the *meaning.* Is the proposition "men are mortal" categorical or hypothetical? In other words do you mean to call attention to the actual men, or do you wish to direct our thoughts to a certain relation, a necessary connection between mankind and mortality? Clearly the latter is the main purpose, and the former, in so far as it appears at all, is very slight. Take the proposition "the roads are bad this spring." Here the main

purpose is to direct attention to the actual roads, as if pointing with the finger. Altogether subordinate to this purpose, we may detect also the suggestion of a law or universal relation.

In certain propositions the reference to objects is very direct and prominent, while the suggestion of a general law of connection is extremely thin and shadowy. In others, supreme emphasis is laid upon the idea of necessary connections of qualities, the reference to objects being very slight and indirect. A series of propositions might be arranged so as to exhibit the gradual growth of one feature and the gradual decrease of the other.

Look first at the impersonal, "it rains," "it is cold," and the demonstrative beginning with "this," "here," "now," etc., as "this is the place," "now is the time," "that is green." We are concerned in these merely qualitative judgments with matters of fact. When we pass from these to the class in which comparison is involved, as "this is heavier than that"; and still more, when we go on to examine those in which the idea of quantity becomes more definite, as "there are ten sticks," "this is three times as heavy as that," we become aware of the gradual emergence of the idea of the relation of the objects to something else. That is to say, in the judgment of quality the reference to objects is so direct as to overshadow everything else; whereas in the judgment of quantity you have brought out the element

of relation, since all measurement requires a standard of comparison, a unit of some kind.

So in "collective" judgments or "judgments of enumeration" in which an attempt is made to sum up one's remembered experiences. "Every one of so and so's novels has an unpleasant ending." "His financial ventures have always been successful." Here we notice a still further development of the idea of necessary connection.

It is when we reach the so-called generic judgment, that we see the categorical judgment merge into the hypothetical. The judgment, "every triangle inscribed in a semi-circle has a right angle touching the circumference," might be reached as the result of reflection upon one's experience with semi-circles. Whether this is to be stated in the form given or in the "if,—then" form is a matter of convenience depending on the purpose we have in view.

Summary.—There are, then, three typical stages of judgment which may be conveniently indicated by the forms (1) A is C. (2) If A is X, it is C. (3) A is either B or C. These type forms exhibit in different degrees the character of a system. The first is the simple judgment of fact,—*Categorical*,—by which we assert that so and so is the case, definitely and directly as if pointing at an object with the finger. The second,—*Hypothetical*,—while making no such direct reference to reality shows us that the members composing the whole or system are

related to each other in a certain way, and this relativity of parts is ground for the judgment that if A is X, it is C. The third type,—*Disjunctive*,—calls attention to the system, ***not in its relation to anything else***, but as a ***self-related whole*** with an individuality of its own. The judgment A is either B or C carries with it the necessity of accepting one or other of the alternatives which, in a true disjunction, must be mutually exclusive. This type embodies the distinctive features of both the others, and exhibits the contents of the whole system.

CHAPTER VIII.

INFERENCE.

§23. The main difference between Judgment and Inference.—It is usually not difficult to distinguish the every-day judgment from its more fully developed mate the inference. Of course the two are very closely related to each other, and as development is a very gradual process we must not expect to be able to draw a line at a certain point and say that all on one side of the line are judgments without any tincture of inference, and that all on the other side are full blown inferences. We have seen that thought is an active and vital principle, and hence we cannot expect rigid classification of types.

There is excellent warrant, however, for distinguishing these types from each other, and one has no difficulty in detecting the main differences between them. There is a certain directness about ordinary judgment and a certain indirectness about inference that can hardly escape attention. In the former case, as when you say "Here comes the postman," you go straight to the mark. But when you add, "And that must be a letter from home," you are conscious of having reached that conclusion in a roundabout way. You have not opened the letter nor even seen the address on the envelope. And yet on the strength of other facts, which are reached quite directly, you are prepared to affirm and do affirm something which you reach indirectly.

"There is the postman; he has a letter in his hand; It is Monday morning; they usually write for Monday, etc." These propositions are reached by a straight and an open road. We are at liberty to go on a little farther and reach the conclusion that "this letter is from home," on the strength, as has been said, of these other facts. The statement, "The blinds are up in the house across the road," expresses a judgment which possesses this quality of directness. The statement, "Then the Browns have returned," is manifestly the expression of a judgment which is made on the strength of the former judgment, and which has, therefore, been reached in the indirect or roundabout way spoken of.

The following story of Thackeray's quoted by Bosanquet[1] is in point: "An old Abbé, talking among a party of intimate friends, happened to say: 'A priest has strange experiences; why, ladies, my first penitent was a murderer.' Upon this, the principal nobleman of the neighbourhood enters the room. 'Ah, Abbé, here you are; do you know, ladies, I was the Abbé's first penitent, and I promise you my confession astonished him.'"

It is, perhaps, not necessary to multiply examples, as a very little attention to what goes on in the ordinary transactions of life will show us that inferences are being made constantly in our daily and hourly experience. The very progress of knowledge as we shall

[1] Essentials of Logic.

see more clearly a little later on is, as a matter of fact, inferential throughout; that is to say, we are continually reaching conclusions or "making inferences" on the basis of what we directly observe.

§24. Inference as Consciousness of Systematic Relation.—Coming a little closer to the matter we may discover the exact character of the inferential process by recalling what was said in an earlier chapter of the nature of system.

System was defined again and again as "a whole composed of parts so held together by a common nature that you can tell from some of them what the nature of the others must be." Knowledge of system, then, implies two features: Knowledge of the parts and knowledge of the way in which the parts are related. It will be necessary to examine this carefully.

To know the system "wheel" involves knowledge of each part, spokes, hub, tire, &c.; but to know each and every part in its isolation from the rest is not sufficient. We must further know the way in which each part is related to every other. And we are to bear in mind that this relation is not an *accidental* relation, so to speak, but a necessary relation. Our definition said that given some of the parts you can tell what the others must be. Not what they may be, but what they must be. In short, the relation spoken of, the way in which the parts go together to form the whole, is a *necessary* relation or connection. Knowledge of system

means nothing less than knowledge of (*a*) necessary relation or connection (*b*) of items or features or parts.

Now when one possesses knowledge of this kind regarding any system, that is, when one has an insight into the necessary connection of the constituent elements or parts within it, the knowledge he possesses, his consciousness of a necessary relation, his *insight* in short, is exactly what we mean by inference.

The meaning of inference should now be tolerably clear. The discussion in an earlier chapter about Ground and about the distinction between f and conscious necessity in judging contained the gist of what we are dealing with here.

We saw that one of the chief features of judgment is that it is *necessary;* a feature which it possesses by reason of the fact that every judgment has a ground; meaning by ground, as was explained at some length, the necessary relation or connectedness of parts within a system. We saw also that in judging we are in some cases distinctly conscious of this necessity; and that in other cases we do not stop to exhibit to ourselves the ground of our statements, and so the necessity is merely felt. Now this distinction between felt and conscious necessity corresponds precisely to the distinction between judgment and inference.

§25. **Inference as fully developed Judgment.**—The discussion in an earlier chapter upon the growth of knowledge bears directly upon the distinction between

judgment and inference. We laid emphasis there upon the fact that knowledge is a vital as well as a conscious process and not merely a mechanical process of addition of part to part. Knowledge grows; and we may fairly expect to see, in the various examples of judgment in ordinary thinking, certain types which are relatively more highly developed than others. And we find this to be the case. Certain judgments are more complex than others. In what, once more, does the complexity of the more highly developed type consist? This may be readily observed in any of the numerous examples of inference that have been given. If you say that there was frost last night merely because you now remember having noticed the glass or the rime on the grass, or because you have heard or read a statement to that effect, your judgment is of the simple and direct type. If, on the other hand, in answer to doubt or enquiry you say "There must have been frost,—look at the condition of the flowers and leaves"; then your judgment is of the more complex type. In this latter case you not only reassert what you said before: you back up your assertion with a statement of a ground on which it rests; and in so doing you turn the first judgment into an inference. A distinguishing feature of the developed type is that it is put forth not in its own right, as it were, but on the strength of its necessary connection with some other one; which, once more, could never be done, unless the necessity of relation or connection were

clearly in consciousness and not merely felt. There is, perhaps no phrase more frequently used in daily conversation than this: "I don't just see the connection." What is this but judgment at work trying to establish or to discover a ground?

The ordinary judgment made without consciousness of the ground upon which it can be shown to rest is a single and simple movement of intelligence. When we take time and trouble to set forth the ground upon which it stands our thought becomes to that extent complex, and the change in character from simple to complex is evidence not only that mind is conscious but also that it is alive and grows.

§ 26. Kinds of Inference.—Inference, then, is insight into the necessary connection of parts within a system. All investigation, all search for knowledge is thus in its nature inferential, since it must inevitably fall within the limits of some system or other. Now the question arises, do we, in inference, always follow the same line of procedure? Is there, in other words, any possibility of distinguishing various forms of inference?

Now, it is obvious that in order to find an answer to this question we must be guided by what we know of the nature of system. Because, stated in another way, the question simply amounts to this. Is there one fixed order of procedure that must be followed in becoming acquainted with a system, or are there more than one?

In seeking the answer to this question let us take a simple example of system. We may try to find out how progress is made in putting together the parts of a dissected map. A map cut into small squares is placed before us and the problem is to piece it together to form a systematic whole. Now we may suppose in order to keep our illustration clear cut and definite that there are no printed or written words upon the map which might serve as a guide in putting it together, but merely symbolic marks indicating coastline, mountain ranges, and water courses. We do not know beforehand whether the whole when put together will form the map of an island, a peninsula, a continent or a county. All we have is before us: a pile of twenty, forty or a hundred squares, rectangles, and triangles of paper with certain marks upon them.

In such a case there is clearly only one course open to us. We must examine these little bits of paper and compare one with another until after repeated trial and failure we are lucky enough to hit upon the way in which they are related to each other; and we are able to lay out the whole map perfect and complete. We are furnished with no clue. We are compelled to discover one for ourselves.

Let us suppose another and different case. There is thrown down on the table before you a pile of cuttings as before, and you are told: "That is a dissected map of a peninsula with a range of mountains running

the long way of it." Here the mode of procedure differs sharply from that in the former case. The course to be followed is plain. Taking as a starting point not what you are able to learn by direct observation of the separate parts, but what has been given in regard to the character of the map as a whole, you proceed to determine the relative position of the several parts. Each part as it comes up is looked at in the light of what we know of the nature of the system as a whole, and its place determined. The process is continued until the whole is complete.

We are now in a position to give an answer to the question we began with. Clearly we do not always follow the same course of procedure in the process of inference.

There can be no doubt that the process in each case was a process of inference. When the work was done a system had been built up. Knowledge of the system meant knowledge of the necessary connection of the parts within it; or to use the term already employed, there was in each case knowledge of the "ground" and knowledge of the parts as determined by the "ground." We may be quite sure that whatever our starting point and whatever our course of procedure, the result of an inference is always the same, namely to furnish an insight into the connection of the parts within a systematic whole.[1]

[1] See Creighton's Introd. Logic. Chap. xxiv, §88.

This, then, being the result we aim at in every case, our starting point and our consequent mode of precedure must be determined by the character of our problem and the material we have to work with. There are but two forms of inference, though there is but one result. In one class of problem we begin with the *parts* given to us in their isolation and without definite knowledge as to the ground. In the other class we begin with the *ground* as given. In the first case our problem is the discovery of ground, the separate features or items or parts being given. In the second we have to determine the parts in the light of the principles of connection as given.

The terms used to designate these two forms of inference are **Induction** and **Deduction.**

Induction signifies the process of constructing a system by the discovery of Ground, or principle of connection of observed facts, the facts being presented in isolation.

Deduction, the process of determining the details of a system where the Ground is given.

We are, therefore, now to enter more minutely upon the study of systems and system-making; and our plan of procedure will be to look first at the process of system-making. We shall have to begin with observation and shew how this leads to classification (and definition) and further to the discovery of causal relations. We shall then be able to see that the right use of these methods carries us forward to the formation of Hypotheses, and

so to a complete explanation of the facts or phenomena we started out to observe and explain.

It is only necessary to add at this stage that the process called Induction is a process of observation and construction, of discovery in short, only up to a certain point. After that point there is a distinct change in the character of the process. It now becomes deductive in character. This will be made clear later on. It will be shown that to verify a guess or conjecture we begin with the postulated system, and, knowing the ground, proceed to determine the details necessarily involved, our purpose being to compare these results with the actual facts of the case.

Deduction simply consists in going from ground to details. Induction is a process of discovery of ground, and obviously must involve as a necessary part of the whole investigation, a process of *verification*. This verification includes (1) deduction, (2) comparison. There is, first, deduction in answering the question, "If my guess as to the ground that I am seeking is the right one, what inferences, what conclusions can fairly be drawn therefrom?" There is, second, comparison of the facts of the case, as they actually are, with the conclusions so drawn.

Summary.—Judgment is reached directly and inference indirectly. When we can trace the path by which any given conclusion was reached, when the felt necessity of ordinary judgment becomes a conscious necessity

we are said to infer. Inference in thus exhibiting the ground or necessary connection of parts within a system is more complex, and more highly developed than judgment. The transition from ordinary judgment to inference illustrates the *vital* character of intelligence which is denoted by the statement that knowledge grows. The two forms of inference, deduction and induction, *differ* from each other in starting point and mode of procedure. They *resemble* each other in result, that is, they both exhibit finally the connection of parts within a system. Induction proceeds from parts, given or found, in isolation, to the construction of the system by searching for the ground; deduction proceeds from the ground of the system, as given, to a determination of the parts.

PART III—SYSTEMS AND SYSTEM-MAKING

CHAPTER IX.

OBSERVATION.

§ 27. **Observation and Explanation.**—We must not for an instant lose sight of the fact that knowledge always aims at Explanation. All the work of Observation is simply a step or series of steps leading directly to that end. And it must be borne in mind that every step in Observation does, as a matter of fact, bring us nearer to our goal, is really a step in advance, carries us forward a stage in the whole process of Explanation. That is to say, we are not to think of the process of Observation as possessing a peculiar character of its own; and of Explanation as a process possessing a peculiar and entirely different character. No. We deal here with Observation by itself and with Explanation by itself, not because of any absolute distinction between the two, but simply because these processes can be more conveniently treated separately.

In observing things we always have a purpose in hand, and guided by such purpose one result of our Observation is a more or less systematic ordering and arrangement of our facts; or more briefly we may say that Observation endeavours to arrange facts in systems. To explain anything, as we have seen, is to give it a

place within a system. In this view we are entitled to say that every step in Observation helps to explain, is, indeed, so much Explanation.

§ 28. Observation and Conscious Purpose.—What progress could we possibly make in knowledge of the world about us, unless we were guided by a conscious purpose in all our efforts? It has been well said that simply to stare at things does not give us knowledge, that facts do not pass over ready-made into the mind. Different observers will, as was pointed out in an earlier chapter, get widely different results and make entirely different reports after observing the same group or series of facts. There is a good reason for these differences. They are due to the differing purposes which guided the observers. A third person with a third different purpose going over the same ground will bring in a third different report. And a fourth person without any purpose whatever to guide him will not observe anything at all.

A story is told of one of the pupils of the great Agassiz, who stared for half a day at a fish which his teacher had asked him to observe, but in that time did not discover anything new about it. To amuse himself he took a pencil and began to draw the fish, and very shortly found out a great number of interesting facts about it. The story goes on to tell how for three long days the student continued to examine the fish, and how in after years he was wont to declare that it was the

best zoological lesson he had ever received. The real point of the story is that no amount of purposeless gazing will ever add to our knowledge. When the student formed the purpose of drawing the fish and proceeded to do so he immediately began to get results.

The idea that successful observation is always guided by a conscious purpose and further that such purpose is always relative to our practical interests hardly needs emphasis here as these topics were pretty fully dealt with in Chapter II. Suffice it to say that the problem of explanation would never be solved if it were not for the presence of a conscious purpose in all our work of observation. Here again we come upon the fact that there is no strict dividing line between observation and explanation, that observation so far from being a mere "passive reception of impressions" is itself an active process of interpretation. Every judgment as we have seen is an act of interpretation.

We should note further that, in observing things about us under the spur of some purpose or end which we wish to accomplish, we do not lay equal emphasis upon every feature or phase of the matter in hand. On the contrary some features naturally seem to fall into the background and others to come forward to a position of greater prominence than others. In purchasing an article in a shop one overlooks or forgets the style of hairdressing affected by the saleswoman, or the colour of the paper in which the article is wrapped. In certain cases the

number of the objects observed is important; in others it is their shape or their colour. That is to say, observation involves selection and omission, and requires frequently the nicest sense of proportion in the emphasis laid upon the facts in view of the purpose which guides us.

§29. **Previous Knowledge and Bias.**—From all this it will be fully apparent that observation does not merely train the sense organs. No doubt people who perform experiments in chemistry and the like do receive a certain kind of valuable training in sense-perception. There is the delicate perception of small differences in colour, sound, taste, smell, weight, and so on. But the far more important training which observation of these matters affords is that of the mental powers. In all that class of cases where observation has been going on, it will be found that the power to judge and to infer has been developed.

It is to be borne in mind, then, that success in observation depends far more upon brains than upon mere eyesight. It depends upon the knowledge you bring to bear upon the matter in hand. Every one knows the story of the young lady who went to the World's Fair and "did the whole thing in a day and a-half." "Observation," in other words, to quote Welton,[1] "is not a mere matter of perfect sense organs even when these are united with a concentrated attention and an

[1] Cf. Welton, Op. cit., Chap. xi, §3.

earnest purpose to observe well. Only he observes well who brings much pertinent previous knowledge to the observation."

This matter of the influence of previous knowledge upon observation has two sides to it, of course. What we bring with us to the observation of any matter may have a bad influence upon us. If we have a wide and deep knowledge of the particular facts of the case as well as of related departments of knowledge we are likely to be good observers. But we may bring with us certain preconceived theories as to how the facts ought to look, and unfortunately we are prone to squeeze our facts a little if we are very much concerned to prove our pet theories. This is perhaps inevitable in some cases, and all we can do is to reduce it to a minimum in our own case at least.

It is usual and proper to warn beginners in science to distinguish between what they observe and what they infer. It is an extremely difficult matter to determine in every case what is due to sense-perception pure and simple, and what to thought. To observe, as we have seen, is to interpret. Interpretation always does something more than merely state what is given in sense-perception. It constructs. The materials for construction are one thing; the construction is another thing. The sensations, or groups of sensations, are data, or evidence, as one may say; and upon this evidence we interpret, judge, observe: as, for instance, when we say

on certain evidence, "That is a rubber ball." Strictly speaking, sense presents to us as data or evidence for our judgment a variously shaded circular object. A very little reflection only is needed thus to show that what seems to be observation pure and simple without any tincture of inference is really a construction, an interpretation, based on evidence. If we were conscious of the fact that we are judging on such and such definite grounds the process would be one of inference without a doubt, and, as we have seen, it is always possible for a judgment to develop into an inference by the simple additional step of exhibiting its ground.

To detect errors in observation is not always easy. Of course, the safest course, if we suspect error, is to enquire of ourselves what are the grounds upon which our observation, *i.e.*, our judgment, rests. The cases of error which turn out to be easiest of detection are those in which the ground of judgment is most readily exhibited.

§30. **Experiment.**—We have spoken of observation as implying a conscious purpose, as involving selection and omission of presented materials, and as very largely dependent for its success upon the character of one's previous knowledge. If you have a clear and definite idea of what you are trying to do, and if your knowledge enables you to select exactly those elements which are related to the matter in hand and to omit all others, you have ideal conditions for observation. In fact, under

such conditions, it is possible to conduct experiments. There are of course certain fields of knowledge in which it is impossible to control and arrange things at will, but in certain sciences this is possible, for example, in physics and chemistry, which are spoken of as "experimental sciences par excellence"; and in such sciences much more rapid progress is possible than in those (such as geology and astronomy,) in which what goes on is entirely beyond our control, and can simply be observed.

Summary.—We observe in order to explain. No one ever observes things in an absolutely aimless way. There is always some conscious purpose to be served, and the more clearly we realize to ourselves the purpose in hand the more successful, other things being equal, our observation will be. One of the "other things," perhaps the chief, is the extent of the knowledge we possess regarding the matter in hand. We are to beware of the influence of preconceived theories, and distinguish between what we observe and what we infer.

CHAPTER X.

TESTIMONY.

§31. **Our Dependence upon Testimony.**—Every one knows that there is a peculiar character of liveliness belonging to knowledge which we acquire by direct observation, which is noticeably lacking in that which we obtain at second hand. To read about it from a book or to hear the accounts of those who have seen is one thing; to go and see for yourself is an entirely different thing. It is one thing to read or hear about the icy blasts of winter and another thing to be exposed to their fury. It is a fine thing to read a poem like "The Prairies." It is a much finer thing to see the prairies for one's self. The most effective arrangement of words that can be used to describe the delights of a dip in the water on a hot day is not quite equal to the actual plunge itself.

Nevertheless, we are practically compelled, in by far the largest part of our knowledge, to get along with the testimony of others: for the simple reason that we are unable to observe for ourselves. There are, for instance, those very large departments of knowledge which fall under the general name of history. Obviously we cannot observe what took place before we were here. In these matters one must depend on the testimony, oral or written, of other people. There are departments of knowledge which it is open for any one to study if he

have time and inclination; but no one man can have anything more than a very general knowledge in regard to vast numbers of things. Hence, we are all of us dependent upon the expert testimony, as it is called, of specialists, who have devoted themselves to one small section of human knowledge. Apart from the difficulties of scientific research it may be added that, in a large class of cases, we are compelled to depend upon the testimony of others in regard to ordinary affairs of life.

In early life, in school, and at home, with parents, teachers and playfellows, that blind confidence which is said to be characteristic of childhood is one of the most favourable conditions for the acquisition of knowledge. An individual who should begin his scholastic career with the intense curiosity of childhood and with a strongly sceptical tendency at the same time would not be likely to make much or rapid progress. He would waste too much time examining the ground on which the statements of his books, his teachers and his companions rested. Ordinarily the very gradual growth of the critical faculty leaves the beginner free to acquire facility in what is of far more importance to him at his present stage of advancement, namely, the interpretation of signs used in communication, and the building up, very largely upon the testimony of others, his provisional little systems which will have their day and cease to be.

§ 32. Difficulties in Interpretation.—It is said that there are three questions to ask regarding any assertion or statement. These questions bear upon the meaning, the truth, and the justification of such assertion; that is to say, we may ask: (1) What is meant? (2) Is it true? (3) How do we know that it is true (or not)?[1]

In addition to what we may call the mechanical difficulties of interpretation which concern the mastery of vocabulary and of grammatical construction, there is an ever-present danger of misinterpretation due to inadequate general knowledge on the one hand and personal bias on the other. Interpretation means giving to the matter which is under consideration a place within a system. If your knowledge of the matter awaiting interpretation is vague and unorganized it is difficult to interpret a statement concerning it. And of course bias in any given direction will result in misplaced emphasis, and the thing will not be seen in its proper light and relation.

The statement under consideration might be: "The king enacted and enforced with great strictness the Forest Laws." To interpret this aright one must, in addition to being able to cope with mechanical difficulties in the way of meaning of words and phrases, bring to bear upon it a host of general ideas regarding monarchy and rule, legislation and execution of laws, and social and economic conditions, as well as

[1] Cf. Welton, Op. cit., Chap. iv, § 8.

particular ideas in these subjects, as related to early Norman rule. To the person whose knowledge of these things is vague and misty the statement will have but a shallow meaning. So much for previous knowledge.

As to bias, the same illustration will serve. Let us suppose that this statement has been made to a person who has no knowledge or very little regarding the need of stringent game laws in a country which is rapidly coming under settlement; and who at the same time is full of sentimental ardour for the rights of the oppressed. We may be sure that his interpretation will be very different from that put upon it by the lover of sport or the student of economics.

§ 33. **Belief and Doubt.**—Granting, however, that the best interpretation has been reached, the second question ("Is it true") is now to be answered. The answer can take any one of three forms. We may say "yes;" or "no"; or "doubtful."

We have seen that whatever fits in comfortably with the rest of our knowledge we regard as true. If an idea cannot find a place in any of our systems, it is regarded as untrue. Where we have difficulty, merely, in deciding the rival claims of an idea already in place and another which seems, but not quite conclusively, to fit there just as well, we have suspended or oscillating judgment.

That a man in Canada should be able to hold hourly communication with his friend on the other side of the Atlantic would have been declared impossible not long

ago. A statement affirming the idea would be declared untrue because it did not fit in alongside of the other parts of a man's knowledge at the time—could find no place in any system with which he was acquainted.

When we hear a statement a little out of the ordinary in regard to something about which we have no special interest we are apt to take and to maintain in relation to it a neutral attitude. If we are vitally interested we may proceed to enquire into the subject and ask for proof. This leads us at once to our third question.

In a very great number of cases, especially those which deal with ordinary affairs, and in which we have no present and very pressing personal interest we are likely to accept the statements we hear on the bare authority of the speaker or writer. Where the matter is one in which we are really interested, and in which doubt arises, we may, if the facts alleged are such as can be personally examined, suspend judgment until we have, or make, an opportunity to observe for ourselves. If actual observation is inconvenient or impossible, the good faith of the speaker along with his known ability to judge in things of that kind will go a long way toward helping us to a decision. If our decision is affirmative the ground of our judgment under the circumstances is simply the authority of the speaker or writer. Every judgment has a ground; and in regard to a very large part of the knowledge which we gain during our earlier years, the ground o judgment as to the truth of statements that

we hear or read, and accept, is the authority of the person who so speaks or writes.

§ 34. Investigation and Proof.—But, to come closer to our question, what happens either in school or in adult life when we find the authority of our informant not quite sufficient as a ground for accepting the truth of his assertions, and are not in a position to verify by actual personal observation the facts that have been alleged?

Of course we can enquire of some one else in whose knowledge and good faith we have complete confidence. But is there no other course? Fortunately there is another and very effective method which may be adopted. In courts of law, to take a familiar example of the application of this method, witnesses are subjected to cross-examination as to the statements they have made.

Now the cross-examining lawyer may believe that the witness is deliberately lying, or he may assume simply that the witness is mistaken. In either case, what the examiner has in view is to show that the statements which have been made by the witness are inconsistent either with each other or with some known and generally believed fact or facts. What do we mean by the phrase "inconsistent with each other"? Simply that the statements are not systematic—do not indicate systematic thinking on the part of the speaker. To have a system

you must have consistency. A system lacking consistency is a contradiction.

So it is in ordinary life as well as in court-rooms. The lawyer asks questions like the following:—When you were standing within six feet of the spot did you not hear the words spoken? Is your hearing good? etc. The unbelieving school boy asks regarding the shape of the earth, "How does it come then that we don't fall off when we get round to the lower side?" Lawyer and school boy pursue the same course. Their purpose is to exhibit the necessary connection of parts within a system, and to show that the facts alleged do not fall within a properly constructed system.

The answer to our third question as to the justification of our belief in the statement of another is that we may accept it as true on the ground of the authority of the speaker, or reject it because the individual is lacking in credit or ability to judge; and that apart from our belief in his good faith and experience in such matters, whenever we are unable to bring direct observation to bear, we must and usually do enquire: "Can this statement be shown to be consistent with what we already know of the subject?"

Summary.—It is natural and proper to depend very largely, particularly in early life, upon the testimony of others. The difficulty we first encounter, even when the testimony offered can be relied on, is that of interpretation. Where doubt arises we have still to enquire as to

the truth and the justification of what is alleged. All depends upon the means we have of apperceiving, that is, upon the systems already built up. We must have something to think with; we try to assimilate the new material to our established ideas; and in case of doubt or denial we search for and attempt to exhibit the ground of interconnection of our ideas in systematic form.

CHAPTER XI.

CLASSIFICATION AND DEFINITION.

§ 35. **Meaning of Terms.**—The process of classification is an example of the construction of a system with a view to explanation.

We are first to distinguish between the process of mental organization or construction of observed things according to a certain ground or basis, and that of actual physical arrangement of things side by side in heaps or groups or cases or shelves. We often speak of "getting our books or papers neatly classified" and we may even actually succeed in so arranging them. But of course such physical organization and rearrangement of things can only be carried out after it has been done mentally. It is a mental construction we mean when we speak of classification.

The terms classification and division are often used interchangeably. It may be convenient to use the former to apply to the construction of a system where the objects to be classified are given with no hint of the basis or ground to be employed. In such a case the building up of the classificatory system is a real process of discovery. The latter term could then be confined to the systematic arrangement of members to be included within each class indicated by a generic term whose meaning is understood, and along with it, the ground or basis of division into species. In classi-

fication you begin with the objects as given, and seek to discover the ground and so build up the system. In division you begin with the ground as given and seek to complete the system by placing the objects or classes of objects in an appropriate place within it.

The process of division must not be confused with that of *partition* which concerns itself with the mechanical separation into parts of a single concrete thing It is usual to speak of a plant as composed of root, stem and leaves; or of an animal as having head, body and legs; or of a country as including so many provinces, or states, or territories. We may thus refer to England as a part of the island of Great Britain, and the relation here is that of a part to a spatial whole. We are to distinguish between this process and another in which there is a relation of part to whole in another sense, namely, that indicated by the words *species* and *genus*; and it is this relation which we mean by the terms classification and division.

§ 36. **Rules of Classification.**—What is wanted for successful classification is, chiefly, knowledge of the matter in hand. An Esquimaux would not be able to classify very accurately the contents of a warehouse containing textile fabrics, or electrical machinery, or tropical fruit. What he would require, in order to accomplish his task, would not be supplied by a knowledge of the Rules of Division given below, but rather by an acquaintance with the actual things themselves.

Special knowledge of the matter in hand is the first and indispensable requisite in classification.

The Rules are valuable, of course, but chiefly as a caution to direct attention to any failures in one's constructive thought. There may also perhaps be seen in these rules a certain hint as to the procedure we have to follow in building up the system of classes.

We are guided, of course, by the purpose we have in view. For the purpose of stowing things away in the smallest possible space we might classify books on the basis of their height. A child might conceivably, for purposes of his own, classify them on the basis of colour. The architect and the merchant would likely classify houses on different bases; while the chief of the fire-brigade might for his purpose employ a basis different from either.

It is clear that the important feature in classification is the ground or basis. That there should be a ground, and that there should be but one ground in any system of classification will hardly need any further proof than that which may be presented in an example or two.

No one would seriously put forward the following as a classification of horses:—thoroughbreds, trotters, ponies, draught-horses, bronchos, Shetlands, balky horses and colts; or of books—red, scientific, octavo, quarto, novels and religious; or of metals—white, heavy and precious; or of students—tall, blonde, large, mischievous, dull,

clever, industrious and stout. One can see at a single glance that such divisions are entirely unsystematic. A system is a whole of parts *related* to each other, so that you can tell from some of them what the others must be. Now in the examples given above we have no clue or guiding thread to enable us to tell "what the others must be." We seem to start in each case with a clue, but before going very far we lose it. In the last instance we have "tall," which seems to indicate that height is to be our ground of division. But the next is blonde, which is a matter of complexion. Dull and clever seem related to a common ground, say ability; while lazy and industrious seem to refer to interest.

It will be seen that in the examples given there is a great deal of overlapping as one result of our failure to keep to the one ground or basis, and also that the constituent species, when added together, are not equal to the genus, as another.

To build up a system of this kind, then, we must observe certain rules. These rules bear chiefly upon the question of basis or ground, and are, therefore, simply the necessary consequence of the nature of a system. In every system there must be a ground.

Every Division, then, must be based on a single principle or ground of difference in some attribute common to all the members of the whole, so that the

constituent species shall be exhaustive, but shall not overlap.[1]

It is worth while to notice that the aim of classification at the present time is not exactly the same as in the past. Formerly the idea was to discover an arrangement of species which were thought of as fixed and unchangeable and separated from each other by boundary lines never crossed and never to be crossed. The present day idea is that "types" are artificial and that they really shade into each other by hardly perceptible gradation. The object is now to exhibit an hierarchy of classes showing successive development of one principle.

Finally, we must observe that the building up of a classificatory system involves, as do all inductive processes, a series of guesses, conjectures, or hypotheses.

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[1] "A good Division or Classification should be appropriate to the purpose in hand; co-ordinate classes should never overlap, and at every stage of a Division or Classification the co-ordinate classes should be identical in application or extension with the co-ordinate classes of every other stage, and with the Summum Genus, *e.g.* in the following Division or Classification:—

TRIANGLE (1)

Equilateral (2) — Equiangular (5)

Isosceles (3) — Acute-Angled (6), Right-Angled (7), Obtuse-Angled (8)

Scalene (4) — Acute-Angled (9), Right-Angled (10), Obtuse-Angled (11)

the co-ordinate classes (2), (3), (4), having for basis of division the proportionate length of the sides, do not overlap, nor do the co-ordinate classes (5), (6), (7), (8), (9), (10), (11), which have for basis of division the size of the angles; the co-ordinate classes (2), (3), (4), are identical in extension with (5), (6), (7), (8), (9), (10), (11), and each of these two groups of classes is identical in extension with the Summum Genus (Triangle), that is, they contain the very same objects."—Constance Jones, *A Primer of Logic*, Chap. vi.

We ask ourselves the question: "Upon what ground can we proceed in classification in this case?" We may be lucky enough to choose the right ground on the first trial or we may make many unsuccessful guesses. In any case we must proceed to work out the details of the system on the ground chosen, and compare our results with the facts as they actually are.

§37. Two kinds of Definition.—(1) Division of a genus into its constituent species is sometimes spoken of as extensive definition. Certainly one of the best ways of showing what we mean by any given term is to treat it as the name of a class which it is possible to subdivide into other classes.

(2) There is another method of definition, however, sometimes called by the name of **Logical Definition**, and this kind of definition requires the division of a genus into constituent species as a preliminary to its formulation in language.

We may, for example, divide man into species on a certain basis or ground, geographical distribution, language, race, colour, or what not. This will give us a system which we may represent as follows:—

MAN.

Caucasians,	Mongolians,	Negroes,	etc.

Now, while, as we saw in the preceding paragraph, this systematic division enables us to define the genus

'man' *extensively*, at the same time it furnishes us with an *intensive* or logical definition of each of the species. We must, of course, understand the system in any case; and we must know the ground of the system, which in this particular instance is *colour.* And knowing this much we are at once in a position to frame a definition which shall say in general terms that the species falls under a certain genus, and differs from the other species in certain respects. In this case we can say, the Negro (species) is a Man (genus) black in colour (differentia).

It may be necessary to add a word or two respecting these three words, "genus," "species," and "differentia." But before doing so it will be possible to examine a few definitions of well-known terms, and to observe that there is in all definitions a regular conformity to this general plan of structure. That is to say, we shall find that most terms are defined by stating the *genus* to which they may be thought of as belonging, and then mentioning the specific *difference*:—

> A triangle is a rectilinear figure, *having three sides.*
>
> Man is an animal, *having the power of speech and reason.*
>
> Histories are books, *which treat of the actions of men in society.*
>
> Fallacy is error, *in inference.*
>
> Ethics is the science of *men's duties.*
>
> A sentence is the expression of *a judgment.*

§ 38. Genus, Species, and Differentia.—Observe first that the terms genus and species are relative terms—apart from each other they have no meaning; and a term may be regarded from one point of view as a *genus*, comprising, within or under it, other classes, and from another point of view as forming part of some larger class. In the first example given above, *triangle* is taken as a *species* of the *genus* rectilinear figure; it may be thought of as a *genus* comprising various *species* of triangles, isosceles, equilateral, etc. So, *man*, in the second example, is regarded as a species of the more comprehensive class or genus *animal*; but may be considered as including, as species, Caucasians, Negroes, etc.

Differentia denotes those qualities, or characteristics, or marks which distinguish a species from the genus to which it is subordinate and from the other species of the same order. *Having three sides*, thus, differentiates triangles from other rectilinear figures. *Treating of men's duties* is that which distinguishes the science of ethics from other sciences.

To put the matter in another way. Terms are used for two different purposes. (1) One of these purposes is *to name and identify individuals and classes*. The term "metal," for example, is used to point out, refer to, denote, the different objects that go by that name—iron, gold, silver, etc. The term "man" similarly indicates this man, that man, the King, Thomas Atkins, as well as the various classes of men—Caucasians, Negroes, etc.

(2) Terms are employed also *to suggest qualities* as well as to point out objects. Every term, thus, is said to be significant—to have meaning. "Metal" makes us think of certain properties which every one of the things to which it refers necessarily possesses; the properties suggested in this case being simplicity, a certain lustre, and the power of conducting heat and electricity. The term "man" implies that the objects referred to possess certain qualities—reason and speech among others. Briefly a term *denotes* the objects for which it stands, and *connotes* the qualities which they possess.

Now, when we compare two terms which are related to each other as genus and species, such as "animal" and "man," we can see at once that the generic term denotes more, and connotes less, than the specific one. "Animal," that is, refers to a larger number of objects than does the term "man"; while the term "man" connotes a larger number of qualities than the other.

It is just at this point that we need a word which shall stand for this difference between the connotation (or sum of qualities) of the *genus* and the connotation of the *species*.

The word *differentia* is used to indicate the surplus. Men and animals have certain qualities in common, life, power of movement, etc. The additional qualities possessed by man constitute the differentia.

§39. **Rules of Definition.**—A definition, then, is an attempt to set forth in a compact way the essential

features of a system. If our knowledge of the matter in hand is systematic our definition will be a good one. If we have not an accurate idea of the system that inaccuracy will be reflected in any definition we attempt to frame.

"Obscure, figurative or ambiguous language," against which logicians in all ages have warned us is just the natural outcome of our thought when we fail to attend to the essential features of the system under consideration. We must remember that explanation requires systematic thinking; and it does not make for clearness to say that light is a "bright essence of bright effluence increate," which phrase was once quoted, as a serious attempt at definition by a school-master who did not clearly distinguish between poetry and science. "To call the camel, 'the Ship of the desert' is a suggestive and luminous description of a property, but it is not a definition. So, with the noble description of Faith as 'the substance of things hoped for, the evidence of things not seen.' But if one wonders why so obvious a 'rule' should be laid down, the answer is that it has its historical origin in the caprices of two classes of offenders, mystical philosophers and pompous lexicographers."[1] "A child would not probably receive much assistance in understanding what 'network' is from the definition given by Dr. Johnson—'anything reticulated or decussated at equal intervals, with interstices at the

[1] Minto, Logic, Inductive and Deductive, p. 101.

intersections.' Such examples make it clear that a pedantic insistence on definition may do much to hinder the comprehension of meaning. The ordinary dictionary recognizes this, and the majority of the 'definitions' of the words of common language which it contains are descriptions rather than definitions in the logical sense. Common sense tells us that such descriptions are often exactly what we want. To see a net and think out its purpose gives more content to the idea than to learn not only such a definition as that of Dr. Johnson, but any definition that could, in all probability be framed."[1]

Another requirement is that a definition should not contain the name defined or any word or phrase directly synonymous with it. Life is the sum of vital functions, cheese is a caseous preparation of milk, veracity is truth, are examples usually quoted as violations of this rule. "To describe a viceroy as a man who exercises vice-regal functions may have point as an epigram in the case of a faineant viceroy, but it is not a definition."[2]

Professor Welton's remarks upon this rule that the definition should not be mere tautology are worth quoting :—"It by no means follows, however, that such tautologies are useless. They generally consist in affirming that a new and unfamiliar term means exactly the same as a familiar one. A child might well know what truth is, and yet not recognize it under its new

[1] Welton, Op. cit., Chap. xvi, §6.

[2] Minto, Op. cit., p. 100.

label of 'veracity'; to learn that the two terms are synonymous increases his knowledge of language though not of virtue. The common definition, 'A noun is a name' comes under this head. Logically it is a tautology, but practically it enables the child to ticket a familiar idea with a technical label. To ask him to define a name would simply be to confuse him, for it would be to insist on an analysis of an idea so simple to him that no analysis is required, and no analysis would make it clearer."[1]

The rule which requires that a definition should wherever possible be affirmative rather than negative is none the worse for the presence of the qualifying phrase, "wherever possible." It is frequently helpful to say what a thing is not. When we know what must be excluded from the meaning of a term we are often well on the way to an understanding of what the meaning includes.

There is one other rule of definition which is nearly always quoted in this connection. "The definition should be exactly equivalent to the class of objects defined, that is, it must be neither too broad nor too narrow." All that it contains, however, is fully covered by the formula with which we set out, namely, that the definition should give the next or proximate genus and add the differentia. To define words as the signs of thoughts is not accurate, because there are other signs.

[1] Op. cit., p. 232.

And again, the definition of a triangle as a rectilinear figure with three equal sides and angles is too narrow.

Summary.—The "rules" of classification and definition may be seen to derive their meaning from the nature of system. Classification involves the observation of isolated facts with a view to discovering the ground of their connection. Definition sets forth in compendious form, usually by genus and difference, what is included in the meaning of a term. Where there is no higher class under which the idea can be subsumed we can only give equivalent phrases. Individual objects are described rather than defined. The purpose of these processes is to lead towards explanation, and this purpose must finally determine the value of all our classifications and definitions. Rules are practically valueless without knowledge of the matter in hand.

CHAPTER XII.

HYPOTHESES.

§ 40. Meaning of the Term.—Beginners in chemistry sometimes entertain the idea that that branch of knowledge comprises only certain processes that occur with an accompaniment of fireworks and vile smells, in laboratories where there are complicated instruments and "substances" with hard names. So the terms hypothesis and theory are thought by some to belong exclusively in the realm of science, and to have no application to the life and thought of the everyday world. The man of science, however, has no monoply in the formation of hypotheses. Indeed, it is more than probable that the average "scientist" constructs fewer hypotheses per annum than the man in the street. Though it is but just to add that the former is likely to make up the deficiency in other ways.

We are not, then, to think of an hypothesis as some rare and mysterious thing or idea or process connected with the solemn ceremonial of science. On the contrary the term must be taken to include the guesses, conjectures, suppositions, assumptions and explanations of everyday life, as well as such matters as the nebular hypothesis or the germ theory of disease. It has been said that "all attempts at the organization of facts into knowledge proceed,....by way of hypothesis[1]"; and

[1] Welton, Op. cit., Chap. xiii, p. 166.

that "the hypothesis of the investigator differs from the comparatively rough conjecture of the plain man only in its greater precision."[1]

§41. **Hypothesis and Explanation.**—An hypothesis is the reply to the question, "How do you explain these facts?" Explanation can only go forward by way of system. Hence the demand for explanation may be understood in every case as requiring us to find an appropriate system into which the facts will fit. If we were to observe a crowd gathering in the street and men rushing excitedly forward we should at once begin to form some hypothesis to account for the occurrence. The idea of a fire might be the first to enter our minds, and if we were unable or unwilling to go out and observe matters directly we should in all probability content ourselves with the thought:—"If it is a fire we shall presently see or hear the fire engines coming." The coming of the engines would be a confirmation of our hypothesis. If, however, the fire engines after a reasonable interval did not appear we should then be compelled to throw aside the hypothesis for a new one. In the meantime some other feature in connection with the conduct of the crowd might have been remarked, and have led us to say that perhaps there has been an accident.

This new conjecture or hypothesis now holds our attention and we are on the look out for any fact or

[1] Dewey, Studies in Logical Theory, Chap. vii, p. 182.

incident which may afford support for it. This hypothesis in its turn may be rejected and another put forward, and the process of suggesting possible explanations and testing their value by examining the facts would or might go on until a satisfactory conclusion was reached. And so the course of our thought in such a case might be indicated by the following,—"That is a fire?—No; an accident?—No; a dog fight?—No; men fighting?—Yes."

Any one who reads stories of Sherlock Holmes and his kind can become acquainted with the way in which hypotheses are formed and tested. Equally interesting is the history of the formation of hypotheses to explain the facts of any of the departments of science. As examples, take the hypothesis put forward by Copernicus to explain the motions of the heavenly bodies; or that by Newton called the theory of gravitation to explain the phenomena of falling bodies; or the theory of protection, or of free trade, in economics. Whatever realm of thought we enter we find facts awaiting explanation. "All reception of facts, whether by observation or, from testimony, challenge the mind to fit them into a system by relating them to each other. . . . The answer to this challenge is a hypothesis or supposed relation suggested by the facts themselves."[1]

[1] Welton, Op. cit., Chap. xiii, p. 166.

In the foregoing we have used the words theory and hypothesis indifferently. In strictness it is better to use the term hypothesis to denote those conjectures and guesses which have been put forward to explain facts but which have not yet been completely established. A theory is a conjecture or hypothesis which has stood the test for a considerable time.

Enough has, perhaps, been said in the preceding pages to warn the student of the dangers of bias in the formation of hypotheses. Emphasis has also been laid upon the influence of previous knowledge in observation, and the same applies equally here. What is practically meaningless to one person may be full of significance to another. Skill and success in explaining things depend upon the breadth and accuracy of one's general knowledge, quite as much as upon insight and a happy faculty of guessing.

§42. **Useful Hypotheses.** — A feature of first-rate importance is that an hypothesis invariably takes the form of a system, and hence is of such a nature that deductions can be made from it. Indeed, it is difficult to see what use an hypothesis could be to us if it did not admit of inferences being made from it. The servant-girl's theory that the milk turning sour was due to the fairies is of no use as long as we are ignorant of the nature of fairies. If we had some definite knowledge of how fairies act we could readily show whether there existed any necessary relation between their behaviour and the phenomenon in question. The hypothesis that one's experiences in life are due to having been born under a particular star is open to the same objection. Nothing is known of the starry influences, and hence no deductions can be made regarding them. The only satisfaction that any one can get out of forming

hypotheses of this kind is in the reflection that if they cannot be proved, it is also quite impossible to disprove them.

It may be worth while to consider a typical case or two of hypotheses which possess the quality spoken of. On coming home you find the door unlocked, and this fact challenges an explanation. Your first conjecture is that your friend who carries the other key has entered the house. That is an hypothesis from which something can be inferred, as, for example, that he must be in the house now. That is a matter which is easily ascertained. If the hypothesis is disproved, you start another. Perhaps thieves have been at work. On this supposition you fairly infer that something of value will have been taken. That can readily be determined. Next a question may arise as to how they gained an entrance and carried away booty without attracting attention; which must be met in the same way, namely, by an hypothesis from which something may be clearly deduced. You form the hypothesis that the thieves entered and quitted the premises by way of a back window and that the circumstance of the front door being open is intended to mislead. If they entered by such and such a way there would inevitably be certain marks; this is looked into, and so the process goes forward.

We see then, from the examples given, the quality upon which it is desired to lay emphasis, namely, that

the useful hypothesis is the one from which deductions can be made. And a little reflection will show that this quality is the only one which can be regarded as essential, and that, as was stated at the outset, an hypothesis possesses this essential requirement by reason of the fact that the form which it invariably takes is that of a system.

§43. **The Testing of an Hypothesis.**—How do we decide that an hypothesis is true or false? We have but to recall some of the examples already mentioned in order to see that there is a general method of procedure that one is likely to follow almost unthinkingly. There are two distinct steps, it will be noticed, in any case we may select at random. A child is lost and those interested at once begin to form conjectures or hypotheses to account for the circumstance. Some one suggests the idea that an accident may have occurred at the swimming pond. Now, leaving out unnecessary details, our first step is to say: If this hypothesis is true, then there are certain deductions to be made, *e.g.*, that the boy's clothing will be found on the bank of the creek or that the body will be found at such and such a point, carried down some distance by the current. The second step would be to compare these conclusions or inferences with the actual facts, which we should immediately go forward to investigate, by direct observation. We should proceed at once to look along the creek for the boy's clothing, or search the bottom of

the part of the stream spoken of. The hypothesis is proved if the deductions and the actual facts agree, or disproved if they do not.

What we trace easily in this simple example is to be found in every attempt to prove the truth of an hypothesis. The history of science shows that the establishment of hypotheses is an extremely slow process. Men of science recognize the need of caution and are prepared to test their theories by the ascertained facts of the case. The result has usually been that first conjectures or guesses prove incorrect when submitted to this necessary test; and the next step is to modify the hypothesis in some way. It usually requires more than one favourable fact to establish an hypothesis, while on the other hand, a single adverse fact is all that is necessary to annul it; consequently science must proceed slowly and painfully. It is told of Kepler that "he tried and rejected nineteen hypotheses before he hit on the laws of the motions of the planets round the sun."

Stated in general terms, the testing of an hypothesis requires two distinct stages or steps. First: we assume that our hypothesis is true, and then proceed to show what inferences can fairly be drawn from it.

Second: we compare these conclusions (which must be true if the hypothesis is true) with the facts of the case as we actually find them in direct observation; and upon the agreement or disagreement, as the case turns out, of the reasoned results of an hypothesis with the

actual facts of the case, we judge our hypothesis to be true or false.

§44. **The Formation of Hypotheses:** (1) *The Spur of Interest.*—The general nature of hypotheses having been explained, as well as the method of their employment, we may now inquire into another and more difficult question — namely, the way in which we proceed in their actual formation; or, in other words, how do we manage to hit upon the right system?

The question may be still further simplified. As we have seen, the discovery of the right system is very frequently a slow process marked by trial and rejection many times repeated, so that for the present we may confine ourselves to the question · What guides our conjectures or guesses toward the system which shall embody the explanation we seek?

First of all we should not forget that in all these cases there is a real need for an explanation—a practical purpose to serve. We do not spend our time and mental energy hunting about for hypotheses to explain things that we are not vitally interested in. Vitally interested may seem an unnecessarily strong phrase to describe what may on occasion seem to be a passing whim of curiosity, or a matter of mere aesthetic taste. But we are to bear in mind that even what are called *hobbies* are rightly included within the range of one's practical and aesthetic interests.

The formation of an hypothesis, then, may be regarded as a practical problem undertaken frequently under the spur of a driving necessity. Whatever hypothesis we form in a given set of circumstances is formed under the consciousness that we must act in some way.

Our plan of dealing with the problem will of course depend not only on the nature of the problem itself but also upon our own mental equipment and habits. If the problem is one requiring the discovery of a cause of certain observed facts our already acquired systems of knowledge in that field come readily into the foreground of consciousness by the law of association. Even our personal hopes and fears it will be admitted have a strong influence in suggesting to us probable explanations in certain cases. Previous knowledge of a boy's venturesome disposition combined with natural concern for his personal safety seems sufficient warrant for the formation of the hypothesis of a boating or bathing accident to account for the fact of his prolonged absence from home.

Much of what has just been said may be regarded perhaps as a mere reiteration with reference to a particular case, of what has been said in an earlier chapter in regard to the subject of interest. That may be so, and yet it is well to insist upon the fact at this point, where we are dealing specially with the problem of construction, of discovery, of investigation, of invention, that necessity is the mother of invention. We have only to recall the

circumstances under which the great achievements of science have come about, to be convinced of the great practical importance of this matter in connection with the direction of the inventive activity of the young.

(2) *Analogy*—Given then a lively interest in the solution of any practical problem either in daily life, or in that frequently too artificial copy of it which our schools create, what more natural than that we should turn at once to our previous experience and knowledge of similar instances for guidance in the case in hand?

Previous experience furnishes us with a case which resembles the present one in certain respects. If the resemblance between the case we are trying to explain and the well-known case which we recall is a very marked resemblance we are apt to apply or try to apply the law or principle which governs in the well-known case to the facts in the other. If we can do so, and the principles apply equally well to both, the ends of explanation have been served.

A very familiar example of this method of analogy, as it is called, is the conjecture that the other planets in our system are inhabited. Most people have thought about the possibility that some of the other planets are inhabited, and the conjecture is probably made in some such manner as the following:—

This globe which we inhabit, (*a*) turns on its axis (*b*) gets light from the sun, (*c*) gets light from a moon, (*d*) revolves round the sun, etc.; some of the planets turn

on their axes, get light from the sun, etc.; therefore some of the planets are probably inhabited.[1] So when one comes upon a collection of stone-age relics in a museum. The very way in which such objects are laid out for observation suggests an argument like the following, which is taken from Bosanquet[2]:—

Cutting tools have edges and places for handles.
These flints have edges and places for handles.
These flints are probably cutting tools.

"An argument from analogy," says Creighton, "may have any degree of value, from zero almost up to the limit of complete logical certainty." Examples may be quoted which exhibit this variation in the value of this form of reasoning.

"The advocates of annual Parliaments in the time of the Commonwealth, urged their case on the analogical ground that a body politic is similar to a living body, and that serpents annually cast their skin, which, being no doubt for a beneficial purpose, might well be imitated."[3]

"The value of an analogical argument will depend upon the nature of the resemblance which is taken as the basis of inference. In general, it is true that the greater the resemblance between the two cases, the more certainly can we reason from one to the other. This is not to say, however, that the value of the con-

[1] See Prof. Lowell's Articles in the *Atlantic Monthly*, Vol. lxxv.
[2] Logic, Chapter on Analogy.
[3] Minto, Op. cit., p. 371.

clusion is in direct proportion to the number of points of resemblance which can be discovered. For example, we might reason: these two men are of the same height, of the same age, live in the same house, come from the same town; the one man stands well in his classes, therefore the other probably does so also. If the number of points of resemblance were the essential thing the argument ought to possess some weight, but it is clear that it has none. The difficulty is that none of the resemblances mentioned are fundamental or in any way essential to the real nature of the things compared. If we knew that the two men were similar in character, this one characteristic would be worth more, as a basis for the conclusion, than all the circumstances which we have mentioned combined."[1]

What is meant by "weighing" the points of resemblance? To weigh anything suggests a balance and a fixed standard, and unfortunately in this figurative meaning of the word *weigh* things sometimes weigh more and sometimes less according to the connection they may find themselves in. A single straw does not amount to much as an obstruction to traffic, but it may show which way the wind blows.

Let us return to the idea of a system: the problem we are now dealing with being set out in the question at the beginning of this section, namely, How do we manage to hit upon the right hypothesis, or as we may say the right explanatory system?

[1] Creighton, Op. cit., p. 207.

The "weight" of an instance, or of a property or quality, that is to say, its importance or value is to be guaged by the position it occupies in a system. The words "value" and "importance" mean just this. Apart from the idea of a system what possible meaning could they have? Value is value for some end or purpose; importance is relative to something.

"Importance," says Bosanquet, "is relation to the purpose or pervading nature, *i.e.*, to the import of any system." A man's height may "weigh" very little, may be of little importance in relation to his prospects as a student, and may be of very great importance in relation to athletics.

Our conclusion, then, is that to hit upon the right explanatory system we must consider the features of the case as significant or highly important features of some system; and the significance spoken of always relates to the *purpose of the system.* The edges and places for handles in the example given above are significant in relation to the purpose, the pervading nature of the cutting tool. Air and water are important features in relation to a system of conditions suitable to maintaining life on any given planet.

§ 45. Development of Hypotheses. — The concrete facts of experience are very complex, and our task is to discover what abstract relations are involved and combined with them. This is not easy, because of the great number of irrelevant features and circumstances in any

group of facts. An hypothesis having been suggested we set to work to separate the inessential from the essential in the mass of material before us, and so lay bare the relation expressed by the hypothesis.

Perhaps the most important, certainly the most usual way of connecting facts one with another is the relation of cause and effect. If our hypothesis is an attempt to connect phenomena in this way our observation may be guided by certain rules or "methods of inductive enquiry."

What is meant by "cause"? "We start, no doubt, by thinking of a cause as a real event in time, the priority of which is the condition of another event, the effect. Pull the trigger—cause—and the gun goes off—effect. The moment we look closer at it, we see that this will not do, and we begin to say with Mill, that the cause is the antecedent which includes all the conditions of the effect. . . . . Pull the trigger?—yes, but the cartridge must be in its place, the striker must be straight, the cap must be in order, the powder must be dry and chemically fit, and so on and so on till it becomes pretty clear that the cause is a system of circumstances which includes the effect."[1] "As the terms are used in modern scientific investigation a cause of any phenomenon is that which necessarily and invariably precedes it; and an effect is what follows, in the same uniform way, some event which has gone before."[2]

[1] Bosanquet. The Essentials of Logic, p. 164.
[2] Creighton. An Introductory Logic, p. 199.

The purpose in view in the use of the experimental methods of Mill is to separate from the concrete facts before us all those features which are irrelevant to the relation of cause and effect. The fundamental principle of these methods is "that whatever cannot be removed without altering the observed phenomenon, is a condition of its occurrence, and whatever can be so withdrawn is in no essential connection with it."[1]

The method of Agreement is employed to test the value of an hypothesis by varying the circumstances in which the relation is observed so as to eliminate the indifferent features. If you have a number of instances of the phenomenon, all differing widely from each other in many respects, and can detect one circumstance common to all, you are justified in judging that that is probably the cause.

An example of the use of this method is the experiment of Brewster in connection with the colour and line of mother-of-pearl, which he proved to be due to the form, and not the chemical qualities or physical composition of the substance, by taking impressions of it in wax, balsam, gum arabic, lead, etc., the colours being repeated in every case.

Bain employs this method to find out what it is that is specially injurious in the north-east wind. Winds, he says, vary in many respects, degree of violence, temperature, humidity, electricity, ozone. He refers to

[1] Welton, Op. cit., Chap. xiv, p. 186.

the "actual instances to see if some one mode of any of these qualities uniformly accompanies this particular wind," and finds that "the depressing effect cannot be assigned to any one of these five circumstances." He observes finally that the north-easterly current blowing from the pole towards the equator is for several thousand miles close upon the surface of the ground, and in the course of its long contact with the ground gathers up a great number of impure elements—gaseous effluvia, fine dust, and microscopic germs; and concludes:—"On this point alone, so far as we can at present discover, the agreement is constant and uniform."[1]

The aim of the method of Difference is to vary one at a time the circumstances accompanying the occurrence of the phenomenon. Instead of comparing a number of differing instances in which the phenomenon occurs we compare two very similar cases, the phenomenon occurring in one and not in the other. This method is "pre-eminently a method of experiment," and is "one of testing and verification rather than of discovery." We consciously or unconsciously employ it in ordinary observation, as for example when we suspect that some article of diet is injurious to us. Here we compare a case where the article was used with one where it was omitted. Observation in such a case is frequently supplemented by experiment, especially when the article referred to is agreeable to the taste. "If a bell is

[1] Bain, Logic, Book III, Chap. vi.

rung in a jar containing air the sound will of course be heard at any ordinary distance. But after having removed the air by means of an air-pump, let the bell be again struck. It will be found that the sound is no longer heard." Our inference is "that the perception of sound is usually connected with the presence of atmospheric air,"[1] since atmospheric air is the only feature present among the antecedents in the one case and absent in the other.

To determine quantitative relations between phenomena the method of Concomitant Variations and the method of Residues are employed. An example of the former may be seen in the connection observed between the Aurora Borealis, magnetic storms and the spots on the sun, although science is yet in doubt as to the mode of connection. Again, "Very often we are not alive to a connection of cause and effect till an unusual manifestation of one is accompanied by an unusual manifestation of the other. We may be using some hurtful article of food for some time unknowingly; the discovery is made by an accidental increase of quantity occurring with an aggravation of some painful sensation."[2] The latter method deals with unexplained remainders, and like the others is constantly employed both in ordinary life and in scientific investigations. To weigh a waggon loaded with hay and afterwards to weigh the empty waggon is a usual method of

[1] Creighton, Op. cit., § 55.

[2] Bain, Op. cit., p. 294.

determining the weight of the hay. The orbit of one of the planets was found not to correspond exactly to what was expected of it after calculating the influence of the sun and the known planets. This perturbation was an unexplained remainder the cause of which was to be sought. The presence of another planet was suspected and in time established.

Summary.—An hypothesis is a guess or supposition which we form for the purpose of explaining the facts of our experience. A useful hypothesis is one which admits of conclusions or inferences being drawn from it. We test the value of an hypothesis by comparing these conclusions with the actual facts as observed. Hypotheses are formed under the pressure of a felt need. The character and extent of our knowledge at the time determine the course of our thought in attempting to hit upon the right explanatory system. Analogy guides us, and an explanation or argument based on analogy depends for its value upon the weight or importance of the points of resemblance noticed, *i.e.*, upon their relation to the purpose of the system.

CHAPTER XIII.

DEDUCTION.

§ 45. The Starting-point of Deduction.—We have seen that the result of an inference, whether inductive or deductive, is always the same—namely, to set out clearly the manner in which the various details within a system are necessarily related to each other; and in tracing this out we have, obviously, a choice of starting-point. We can distinguish an inductive from a deductive inference only by reference to the *starting-point*, and the *direction of movement* in each.

If we have merely the parts without any knowledge of the connecting principle which binds them together, we can start with the parts so given in their isolation, and seek the bond or ground of connection. The movement from the preliminary study of isolated parts or details, facts or phenomena, towards an understanding of the ground, or manner of their connection, is **Inductive.**

If, on the other hand, we know at the outset the relations involved in the system, we can proceed from that to determine the parts in detail. Such procedure, from the ground to the determination or placing of the parts or members, constitutes **Deductive** inference.

Since deductive inference is a process which begins with the Ground of a system, it is obvious that the first and most imperative duty is *to make sure of our Ground;* just as, in inductive procedure, the prudent thing to

do is *to make sure of our Facts.* We are as absolutely certain to go astray here, if we fail to understand the ground of a system, as we are in the other case if we fail to observe accurately the parts out of which the system is to be built.

§ 46. **Two Types of System.**—It will be convenient in dealing with this part of our subject to consider separately two distinct types of system. There are certain abstract systems in which the relations involved are very definite. There are other systems, concrete in character, and marked by a great complexity of relation. Examine a few cases. British Subject, First-class Power, Steel Bridge, Criminal, Government-owned Railway,—these are concrete systems. Isosceles triangle may be taken to represent one, and any given number, say 14, another, of the abstract and definite systems of mathematics. What follows :—

(a) If X is a British Subject.
If Japan is one of the Great Powers.
If this bridge is made of steel.
If this man is a criminal.
If the H. B. R. is owned and operated by the Government.

(b) If a triangle has two equal sides.
If eight and six are added together.

Of a concrete system one is able to make a great many assertions. It is possible to look at the matter in a very great variety of ways, from many points of view.

It is impossible in one or two propositions to give all that is contained within a system of this kind.

If X is a British Subject, then he has certain rights. It would take some time and space to enumerate them. For example, under certain circumstances he is entitled to the protection of the British Consul in a foreign country. He has certain duties, and certain privileges, also numerous. The system is a very large and complicated one, and an enormous number of statements can be made which follow naturally upon the statement of the ground, "if X is a British Subject." So with the others. Let us mention a few out of the hundred things that follow in the second case.

If Japan is one of the Great Powers: then the Japanese must assume their fair share of responsibility in world problems; or the size of Japan's fleet will be a matter of extreme interest to all the other nations; or Japan will influence to some extent the arrangement of future alliances between nations; or Japan will have something to say about the future of China, etc. On the other hand there is no such complexity about the mathematical cases. All that we find there is definite and highly abstract, and we are, therefore, able to exhibit the nature of the system in a few propositions. We may say, if a triangle have two equal sides then there are two angles equal. If eight and six be added together the sum is fourteen. This gives us an idea of how

readily and briefly we may set forth what is contained in systems of this kind.

These two types of system correspond to two types of deductive inference. We have the type of reasoning known as *syllogism* and that known as *construction*. It will be necessary to say a few words about each of them.

§47. **Forms of Argument.**—In reasoning about concrete systems we are not tied down to one fixed form of thought or expression. We were speaking a little while ago about two uses to which terms are put, the purpose of pointing directly to things in the real world, and the purpose of suggesting qualities possessed by these things; or, briefly, the use of terms in denotation, and their use in connotation. These two uses to which terms may be put correspond to two kinds of syllogism.

Looking again at the propositions given on page 140, we may employ the term British subject to point out and identify a very large number of individuals living in various countries, far and near. The term is applicable to all Australians, Canadians, Englishmen, Scotchmen, Irishmen, etc. But the term may also be used to suggest certain qualities or relations. It implies, among other qualities or properties or relations, born, or living under the British flag, an allegiance to the King, possessing certain legal rights, bound by certain duties.

If we are using the term in the denotative sense, the form of our argument would be as follows:—

British subjects are possessed of certain legal rights.
X is a British subject.

Therefore X is possessed of these legal rights.

If, on the other hand, we desire to emphasize the connotative side of the term, our argument is apt to take this form :—

If X is a British subject he will enjoy certain legal rights.

But X is a British subject.

Therefore X enjoys these rights.

Again, the other arguments may be put in either of these two forms. We have :

(*a*) The Great Powers assume the right to say something about Chinese policy in certain matters.

Japan is one of the Great Powers.

Therefore Japan will have something to say about that matter, or :

(*b*) If Japan were a Great Power she would have something to say about China's future.

Japan is a Great Power.

Therefore Japan will have something to say, etc.

(*a*) All industrious men will be successful.

A is an industrious man.

Therefore he will be successful, or

(*b*) If a man is industrious he will be successful.

A is an industrious man.

Therefore he will be successful.

When an argument takes the first of these forms, that is, the form which expresses the denotative way of thinking, it is called **categorical**. The second form, expressing the connotative way, is called **hypothetical**.

§ 48. **The Categorical Syllogism.**—Categorical propositions may be combined in a *Syllogism*. A *Syllogism* is composed of two *Premises* and a *Conclusion*. In books on logic you find the propositions given in a regular order: the first being the *Major Premise*, the second the *Minor Premise*, and the third the *Conclusion*. In real life they do not always follow each other in that way. Ordinarily we have no difficulty in distinguishing the *conclusion* of a man's reasoning from the premises or grounds on which it rests. An argument may be stated thus:—

Socrates is mortal: because he is a man; and all men are mortal.

The conclusions being thus easily recognized, it only remains to distinguish the major from the minor premise, the major premise being the one which contains the major term, and the minor premise the minor term. Now the subject of the conclusion is invariably known as the minor and the predicate as the major term. In the present syllogism we have, therefore, Minor term, Socrates; Major term, mortal; middle term, man.

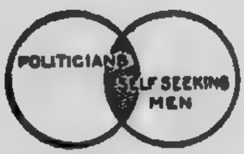
In the categorical syllogism the judgments emphasize the idea of objects or individuals, and classes of objects and individuals, definitely pointed to, and affirm either

that the subject is included within the predicate, or that it is excluded therefrom. The proposition that "all industrious men are successful" affirms thus that the whole class of "industrious men" is included within the class "successful men." The proposition, "no brutes are rational," affirms that the whole class of "brutes" is excluded from the class of "rational beings." To say that "some politicians are self-seeking" is to affirm the inclusion of a part of the class "politicians" within the class "self-seekers." And when we say that "some students are not industrious" we completely exclude a part of the class "student" from the class of "industrious people."

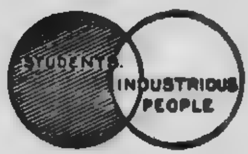
When propositions are interpreted in this way it is possible to represent their meaning by the use of circles. Thus the meaning of the four propositions mentioned in the last paragraph may be indicated graphically :—

I

II



III

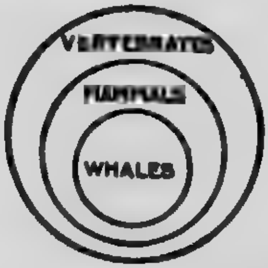


IV

It is also possible, of course, to represent by means of circles the whole argument contained in the two premises and conclusion of a syllogism. Let us suppose the premises to be,

All mammals are vertebrates; all whales are mammals.

This can be represented as follows:—



The rule set down in paragraph 44 was "*Be sure of your ground.*" Here the premises, major and minor, constitute the ground of the system within which we are working. Obviously we must, if we wish to avoid error, correctly interpret the meaning of these propositions. In this case we have properly interpreted them and expressed their meaning in denotation by the use of the circles. The importance of the caution that we should make sure of our ground is shown in the fact that once the propositions setting forth our ground have been properly interpreted, we have not the slightest difficulty in getting to the conclusion.

Nor have we any difficulty in getting to a conclusion from the following premises:—No good man will refuse to defend his country. All the members of the party

are good men. The meaning of these propositions may be exhibited thus :—

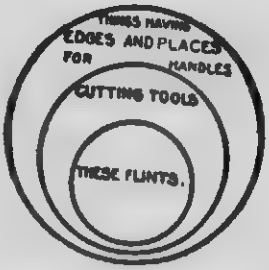
Let us now consider a few cases of premises which do not yield us certain conclusions.

(*a*) Cutting tools have edges and places for handles.

These flints have edges and places for handles.

There is no difficulty about the interpretation of these propositions each by itself; but how shall we exhibit them in relation to each other? Or, in other words, can we here be sure of our ground? We cannot be quite sure. We do not know whether the whole matter should be represented thus :—

or thus :



and therefore, we must content ourselves with the conclusion : These flints may be, probably are, cutting tools.

Is it possible for us to be sure of our ground in a case like the following :—

(*a*) Certain places at certain times are noted for an abundance of flies. These localities at such times are also noted for many cases of typhoid fever.

(*b*) Yesterday it rained in the evening.
All yesterday the smoke tended to sink.

(*c*) Three species of butterflies X, closely resemble three species, T.
The X species would be protected by resembling T (because it is distasteful to birds).

Clearly not. These premises simply serve as starting points which suggest *probable* conclusions, but do not certainly guide us to necessary ones. We are likely to say in

(*a*) Therefore the increase of fever *may* be connected with or due to flies; in

(*b*) Therefore the smoke sinking *may* be a sign of rain; and in

(*c*) Therefore the resemblance *may* be a protective resemblance; *i.e.*, a resemblance brought about by survival of those protected.[1] While such speculations as the last mentioned do not afford any certain conclusions, they are, nevertheless, highly valuable as suggestive of possible explanations. We are not to suppose that those arguments which afford the maximum of cer-

[1] Cf. Bosanquet, 'Essentials,' Lecture ix.

tainty in their conclusions are the most valuable to mankind. Life is not by any means a system of certainties. But what we are concerned with here is to show that in deductive procedure we are led to valid conclusions because of the nature of the ground, or premises, from which we start. If we make sure of the ground we shall be able to distinguish between conclusions which are certain and those which are only probable.

Let us compare briefly a syllogism which leads to a certain conclusion with one which does not.

(1) All m is n		(2) Some m is n	
All p is m		All p is m	
All p is n			

In the case of (1) we infer unhesitatingly that all p is n; while in the case of (2) we do not find any certain conclusion.

The connecting link between the premises in both cases, is, obviously, the *term M*. It is only by means of this connecting link—the middle term as it is called—that we are able to reach any conclusion whatever. Is the middle term employed in the same way in both syllogisms, or is there a radical difference between them? We can readily see that in syllogism (1) the major premise "all m is n," gives us information concerning the whole of the class indicated by the middle term; whereas in syllogism (2) neither major nor minor gives us information about anything more than a part of

the class M. In (1) we have an identical middle term connecting the premises. In (2) we cannot be sure that "m" in the major premise refers to the same part of the class that "m" in the minor premise refers to. Stating it technically, the middle term is distributed in (1) and not distributed in (2). That the middle term should be distributed at least once in the premises is perhaps the most important of the "rules" usually laid down in regard to the syllogism.

There is a rule which prescribes that no term must be distributed in the conclusion which is not distributed in one of the premises; which is a technical way of saying that the conclusion must not assert more than is warranted by the premises. The following illustrates the need of this rule.

All Canadians are in favour of the Imperial connection.

No Australians are Canadians.

∴ No Australians are in favour of the Imperial connection.

Here the major term, "persons favourable to the Imperial connection," is distributed, *i.e.*, taken as referring to the whole class in the conclusion; whereas it is not so taken in the major premise. And our conclusion is invalid because we have gone further than our premises warranted. The student might amuse himself by constructing an invalid syllogism in which the minor term is distributed in the conclusion and not distributed

in its premises. Another rule bears upon the fact that two negative premises cannot yield any conclusion. As we have seen, the connecting link between the two premises is the identical middle term; and if in the major premise the whole or part of the class indicated by the major term is excluded from the class indicated by the middle term, and if there is a similar exclusion between minor and middle in the minor premise, it is obvious that we can not say anything in regard to the relation of major and minor in the conclusion. We shall later on devote a little space to the discussion of the fallacies into which we are led by failure to observe these and other logical rules.

§49. Hypothetical Arguments.—The last few paragraphs have treated of argument in which the terms are employed in the denotative way, that is, as pointing to individuals and classes of individuals. We saw that by drawing circles to represent classes of individuals or objects we could indicate the meaning of the propositions, and shew, literally at a glance, whether a given term was used in its whole extent or not,—whether in speaking of mortals, or vertebrates, or men, or industrious people, we meant all mortals, all vertebrates, all men, etc., or only a part of each of these classes.

The hypothetical syllogism treats terms in their other aspect as suggesting qualities rather than directly

pointing out objects. The categorical syllogism which took the form :—

All m is n ;
All p is m ;
therefore all p is n,—

may appear as follows :—

If p is m, it is n ;
and p is m ;
therefore it is n.

The major premise is an hypothetical proposition, and the minor a categorical. The two parts into which the hypothetical obviously falls are the Antecdent and the Consequent, terms which hardly need any comment.

The student can amuse himself by arranging the premises of an hypothetical syllogism in various ways with a view to formulating the rules which govern its use. He may take the following :—

(*a*) If p is m, it is n ;
and p is m.
What follows ?

(*b*) If p is m, it is n ;
and p is n.
What follows ?

(*c*) If p is m, it is n ;
but p is not m.
What follows ?

(*d*) If p is m, it is n ;
but p is not n.
What follows ?

He may possibly get on better by dealing with concrete cases which have already been given, or which he may invent for himself. He may then state the rules he has discovered in terms of the affirmation or denial of the antecedent or of the consequent.

§50. Construction, Geometrical.—We have already indicated the character of this class of system by the term "abstract" as opposed to "concrete," and by the examples cited from mathematical subjects, geometry and arithmetic.

In the last few pages we have seen that it depends upon the purpose we have in view whether we state the argument that we make regarding concrete systems in the categorical, or in the hypothetical form. We found it possible to set forth the relations involved in any concrete system in the form of subsumption, as it is called, of particular cases under some universal system. In constructing abstract systems, we do not proceed by way of universals and particulars. Our systems being abstract, we can treat of more definite relations than those indicated by "all" and "some"; we are not limited to this one relation, but can readily exhibit all that are contained within the system.

Here, as elsewhere in deduction, our constant care must be to be sure of our ground. Mathematicians in all ages have laid emphasis upon the necessity of accurate definition of terms, and this indeed seems the one essential to success in the construction of an abstract system.

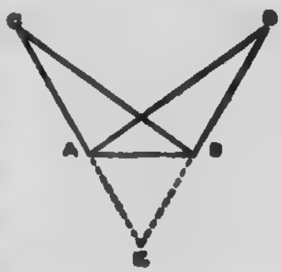
The ideas with which we deal in geometry are based on the nature of space, and the judgments we make regarding geometrical construction take the form of ground and consequent. "If a plane figure is formed of

three enclosing straight lines, then the interior angles together will be equal to two right angles." Here we have an hypothetical judgment which falls naturally into two parts: ground (if ——), and consequent (then ——). The relation being that of space, we can see at once that this kind of ground is to be clearly distinguished from the ground in the case of cause and effect. The idea of time is an essential part of that of causation. The relation of ground and consequent in geometrical reasoning is obviously not of this character. We feel that it would be quite out of place to speak of the equality of the two angles at the base of an isosceles triangle as being *caused* by the equality of the two sides in the triangle.

It is necessary to distinguish sharply between a process of demonstration or proof on the one hand and a process of discovery on the other. In the former case we know the system thoroughly, and are simply engaged in tracing our course from the ground as given or agreed on to the consequences following therefrom. Thus we may begin with an isosceles triangle. Here we have a system of lines and angles bearing certain relations to each other. We undertake to prove that the angles on the other side of the base shall also be equal. The sides are produced and a certain construction made which gives us pairs of equal triangles, with corresponding angles equal, "each to each," and subtraction of equals from equals leaves us an equality of remaining

angles. Here we have a process of deduction, the movement being, clearly, from a ground established by certain definitions of lines and angles to the determination of certain particular relations; the relation being the equality of the angles at the base of the triangle, and those on the other side of the base. This is the kind of reasoning pursued by Euclid in his Elements of Geometry. Certain principles are assumed to begin with, and he goes forward from these, as grounds, to demonstrate theorems and solve problems by a series of inferences which are legitimately derived from these foundation principles. In his problems and theorems Euclid does not take us into his confidence, and tell us how or under what circumstances he came to discover such and such truths. He lets in no kindly ray of light upon the processes of Discovery which must have preceded these convincing demonstrations.

Let us suppose now that we begin with two equal triangles on the same base and on the same side of it, the larger pair of equal angles at the base being obtuse. Thus we have on the base AB the two triangles CAB and DBA, equal to each other in all respects. We have CA and AB equal to DB and BA and the contained obtuse angle CAB equal to the contained angle DBA. Then the bases are equal, etc., a case of the fourth proposition.



Produce CA and DB to a meeting point E; and, by adding the triangle ABE to each of the equal triangles CAB and DBA, we have the sum CEB equal to the sum DEA. Evidently, the two triangles would furnish another case of triangles equal in every respect, *if AE is equal to BE*, a condition which would also make it possible (by subtracting equals from equals), to prove that the angle EAB is equal to the angle EBA.

It is probable that it was in some such way as this that the ancient geometer, whoever he was, was led to see that the condition of the equality of those obtuse angles on the one side of the line is the equality of the two sides of the triangle formed as above indicated, on the other; or, stating it another way, that *given* an isosceles triangle with the equal sides produced, it is possible to show, with the help of a certain construction, that the angles on the other side at the base are equal as well.

In general terms we may say that the process of discovery in the case of a theorem would begin by assuming as true that which it is desired to prove. From this assumption as a ground, certain consequences are shown to follow, and these may be compared and combined with other known or proved truths until the course of our reasoning carries us to the theorem itself. In the case of a problem, in a similar way, we should begin by supposing that what was to be done has been done and from this as a ground, by a series of construc-

tions, we could proceed step by step until we reach the original data of the problem, or some undoubted geometrical truth. It has been remarked that this process of discovery has been found more extensively serviceable in the solution of problems than for the demonstration of theorems.[1]

§ 51. **Numerical Construction.**—The science of arithmetic depends upon time relations. Geometry, which as we have already seen, involves no time relations but is based upon space, may be called the science of space. The science of arithmetic or numbers, although based on time in a certain sense, cannot be called the science of time. The idea of time, however, enters so thoroughly into it that you can reach a numerical idea, say two or seven, only by the relation of ideas in temporal succession. An idea of number can be formed without the assistance of objects in space. Number is a relation, a way of thinking in regard to events in time. Numerical ideas are impossible apart from temporal succession, just as geometrical notions are impossible apart from space.

In reasoning with and about numbers we proceed deductively; that is to say, our starting-point is the ground of a numerical system, and we proceed towards the determination of particular relations within that system.

If the geometrician is right in insisting upon rigid definitions of the terms used in his science, lines,

[1] See Potts' Euclid's Elements, p. 61.

angles, and the like, then certainly the arithmetician is equally right in defining with the utmost accuracy the notions from which he proceeds. Here as well as in geometrical reasoning we must make sure of our ground.

If we have a clear and definite idea of what is meant by any given arithmetical term we have little difficulty in proceeding from this general idea to the particular ideas involved within it. The accurate and precise results which are achieved in mathematics are due in the first place, of course, as we have already said, to the abstract and definite nature of mathematical systems and in the second place to the extreme accuracy with which definitions are laid down. If six meant one thing one day and something else ever so little different the next day accuracy would be at an end.

Numbers cannot be defined according to the method of logical division as laid down in a previous chapter, namely, by genus and differentia. Certainly, when we say that six is five and one we do not think of six as a species of five with one as differentia.

The question as to whether we should adhere to a fixed form of definition ($6=5+1$; $5=4+1$; $8=7+1$), or admit any number of forms as equally valid ($6=5+1$, or $4+2$, or $3+3$, or $10-4$, etc.), has often been debated. It is difficult, however, to see what is gained by the latter plan. In actual practice it seems like complicating the problem unnecessarily to say that 8 is to be "defined" as $5+3$, because you are likely to be asked

at the next step for a definition of 5 and also of 3; and if these terms in their turn are similarly "defined" our problem becomes more complicated than before. In the interest of economy the other plan recommends itself. By proceeding in this way in our numerical definitions we are always ready to give a consistent and coherent account of any term we may employ.

For equally good reasons we may define numbers greater than ten with direct reference to our decimal system of counting; and in this view 15 will be defined as 10 and 5, 21 as 2 tens and 1, 98 as 9 tens and 8.

A few examples of reasoning with numbers will be in place. To add 5 and 4. 4 is 3 and 1. Therefore 5 and $4=5$ and 3 and $1=6$ and $3=6$ and 2 and $1=7$ and $2=7$ and 1 and $1=8$ and $1=9$. To add 7 and 5. The problem here is to express the sum in terms of tens and units. To have ten you must add 3 to 7; and you now have $(7+3)+2=10+2=12$. $15-8=(10+5)-8=(8+2)+5-8=2+5=7$. $16\div5=(10+6)\div5=(5+5+5+1)\div5=3$ fives and one over. 4 times 7. $7+7+7+7=(7+3)+(7+3)+4+4=10+10+4+4=2$ tens and 2 fours $=28$.

In what is called applied arithmetic we have to deal with all sorts of relations in addition to the purely numerical ones. A problem in "stocks," or "interest," or mensuration brings into play moral relations, geometrical relations, the relation of means and ends, and others, which in point of difficulty overshadow the

numerical ones. The question to be faced is not so much "can we perform these numerical operations correctly?" but "which of the operations should we employ in view of the other relations mentioned?"

Summary.—Deduction begins with the ground of a system and seeks to determine the parts in detail. One type of deductive reasoning is known as *Syllogism*. The categorical and hypothetical syllogisms deal with concrete systems, the former emphasizing the idea of objects and classes of objects, the latter looking to the idea of necessary connection of qualities. The definite relations of the abstract systems of mathematics fall under the head of *Construction*.

CHAPTER XIV.

FALLACIES.

§ 52. Kinds of Fallacies.—In previous chapters direct reference has been made to some of the more common of the logical pitfalls. In this it is proposed to go over the ground with some care. We shall try to gather together within close limits the substance of what may be found scattered through the preceding paragraphs, and state in brief form a few of the more important negative rules of logical procedure or general method. We are to consider here the obverse side of the matter. Hitherto we have been dealing with the laws or rules or methods of right procedure in reasoning. If these are understood and followed accurately, of course that implies an understanding of what to avoid. For the sake of emphasis, however, if for no other reason, a few words on the negative side of the subject will be in place here.

In one of his humorous essays, Dr. S. M. Crothers distinguishes valid from invalid arguments in the following way:—"Let us sit down together and pluck up the thoughtlet by the roots, and examine its structure. You may find *some* pleasure, and perhaps a little profit, in these native growths of your mind. When you take up a thought and pull it to pieces, you will see that it is not so simple as it seems. It is in reality made up of several thoughts joined together. When you try to separate them, you find it difficult. The connective tissue which

binds them together is called inference. When several thoughts growing out of the same soil are connected by inference, they form what is called an argument. Arguments, as they are found in a state of nature, are of two kinds: those that hang together and those that only seem to hang together. These latter are called fallacies. . . . . They are the wild flowers of the intellectual world."[1]

The chief logical fallacies to which attention will be called can be set forth more clearly, perhaps, by reference to the nature of system than in any other way.

We have seen that the purpose and result of an inference, whether deductive or inductive, is always the same—namely, to exhibit the necessary connection of parts within a system. But we have also seen that in the investigation or in the building up of any system there are two possible starting-points, and, by consequence, two possible modes of procedure. A system possesses two features. Being a whole composed of parts related to each other in a certain way, any system must involve both (*a*) the parts connected, and (*b*) the manner or way of this connection; or, as we have been phrasing it, there are the *parts* which go to form the whole, and the *ground* of their connection.

In inductive inference we speak of our facts as our starting point, and we have already called attention to

[1] How to Know the Fallacies, or Nature Study in Logic. The *Atlantic Monthly*, [redacted]

the importance of "making sure of our facts." When our inference is of the deductive order we should, for equally good reasons "make sure of our ground." To have both our starting point and our objective or destination clearly in view is what is required.[1] Our problem would then consist simply in tracing our way step by step from the one to the other.

In the construction of a system our procedure is always inferential. Whatever our starting point, the result is the same, namely, to exhibit the necessary connection of parts within it, and insight into the necessary connection is exactly what we mean by inference; or to change the form of expression slightly, in inference there is always a movement of thought along these lines of necessary connection within the system.

Now, employing for a moment the metaphor of a *movement* of thought along lines, as it were, from one point in space to another, we can see that, in thinking, any one of several things may happen. In travelling you may go straight to your destination, or you may take a wrong direction and wander about, or you may actually go back on your tracks to the place you came from. In case of actual travelling a man usually knows when he has reached his objective, he is usually though not always aware of the fact when he is lost, and if he

[1] In the "Logical Basis of Education," Chap. ix, Professor Welton lays down the following as "two closely related and fundamental rules of method: (1) Have a definite purpose. (2) Make sure of your starting point. Neglect of one or both of these leads to *Fallacy*, that is, to invalid thought disguised as valid thought.

returns to his starting point he generally recognizes it as such. Let us see how far thinking and travelling in this way correspond.

We have not at present to deal with those cases where, having a goal definitely in sight, the traveller has gone straight and sure toward it from his starting point. We are concerned with those cases in which he has taken a wrong direction, but is not aware of it. The mischief of it is that, in thinking, we are so endowed with blind confidence in our powers of mental navigation that we do not as a general thing know it when we go astray. We are likely to mistake one position for another, and even to confuse our starting point with our destination.

Suppose, now, that we read, hear, or utter two statements which at first appear to be different from each other but which are really identical in meaning, the difference being merely formal.

And suppose again that we read, hear, or utter two statements which are alleged to mean the same thing, and which do really appear to be very much alike, but which as a matter of fact involve a real difference.

In the first of these cases we have something very much like the traveller who came back to where he started from, and did not recognize his starting point. And in the second, it is as if he has really made some progress away from home, but has missed his objective and is not aware of it.

In the first instance there has been no real progress of thought at all; and in the second there has been a kind of progress but it has led to an idea which we have confused with something else.

We are now in a position to lay out the course which our summing up is to take. We have to deal with those errors which are due to failure to make sure of our starting point; and also with those which in actual systematic construction are due either to imagining a distinction where there is really no identity, or a failure to distinguish in cases where a real difference exists.

§53. Failure at the Starting-point.—A very great deal of our knowledge comes to us on the authority of others through the medium of language, and in many cases we fail to understand exactly what is meant.

The liability to misunderstanding is greatly increased by the fact that words get part of their meaning from their context. To quote Welton,—"We do not begin with ideas of separate things and weld them together, but we begin with a vague idea of a whole which we have to analyze....Knowledge of language, like knowledge of every other part of reality, works at first from the whole towards the elements."[1]

There is room for error in the interpretation of such propositions as "all cruel men are cowards," "all beautiful things are agreeable," "ill-doers are ill-dreaders." We are not entitled to interpret these

[1] Welton, Op. cit., Chap. iii.

statements as meaning that all cowards are cruel, that all agreeable things are beautiful, that all ill-dreaders are ill-doers. That all citizens are entitled to vote does not imply that no aliens are allowed to vote.

Many errors arise from the careless use of language as well as from misunderstanding its use by others. This is particularly true of figurative language, against which logicians constantly warn us. One may be so strongly impressed by a striking figure of speech as to forget to enquire whether or not it is applicable to the matter in hand. The metaphor of the ship of state has furnished political orators with some misleading arguments upon government and how it should be carried on. Metaphors have had their good and their evil effect on educational theory. We freely employ the word "Kindergarten," and are too much under the influence of the theory; for, after all, a little boy is not a plant, and a teacher is not a gardener. In one breath we speak of cultivating our minds, and in the next, of mental digestion or indigestion. We may impose on ourselves as well as others by the use of an ambiguous middle term—that is, a middle term which is used in one sense in the major, and in another sense in the minor premise. Here is a harmless example: Who is hungry eats most; who eats least is most hungry; therefore who eats least eats most. A misplaced accent may result in fallacy. One of the stock examples of what

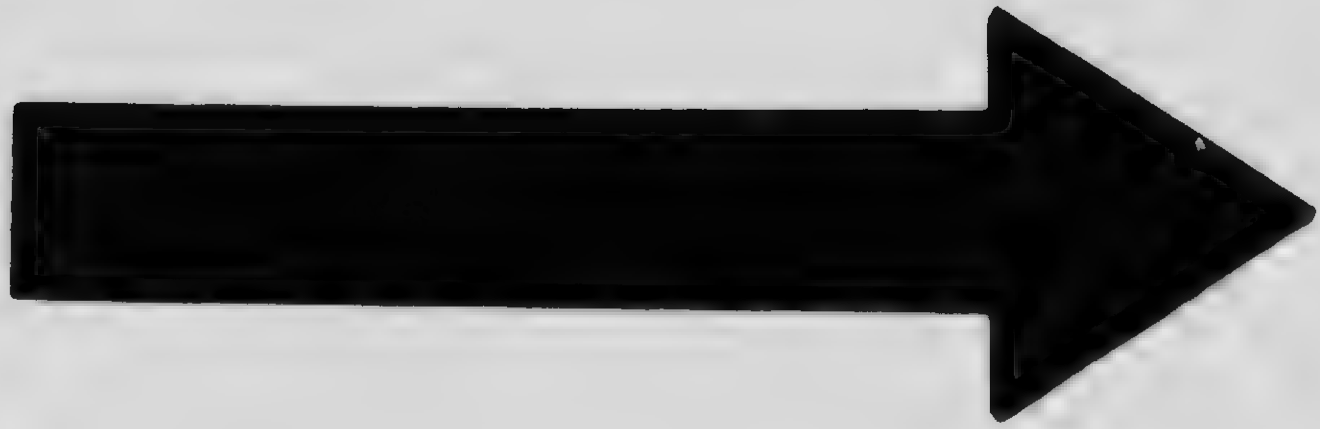
is known as fallacy of accent is to be found in the First Book of Kings, 13th chapter, and 27th verse.

Errors due to inaccurate observation and bias have been dealt with in another place.

§54. Mistaken Distinctions.—The phrase "begging the question" is intended to warn us against the danger of expressing the same judgment in various forms of words, thus allowing ourselves to be misled into the notion that we have really made a step forward in inference. This fallacy is committed, for example, when we "postulate the fact which we wish to prove, or its equivalent under another name," and argue that an act is morally wrong because it is opposed to sound ethical principles, or that the execution of King Charles the First was unjustifiable because kings are inviolable, or that opium produces sleep because of its soporific qualities. Or, again, we may beg the question "by making a general assumption covering the particular point in dispute. Thus, if the advisability of legislation regulating the hours of labour in a mine or factory were under discussion, the question-begging proposition, 'all legislation which interferes with the right of free contract is bad,' might be propounded as a settlement of the whole question."[1]

Professor Welton suggests that perhaps the most common form of committing this fallacy is the acceptance of sham axioms generally and the use of them as

[1] Creighton, Op. cit., §46.



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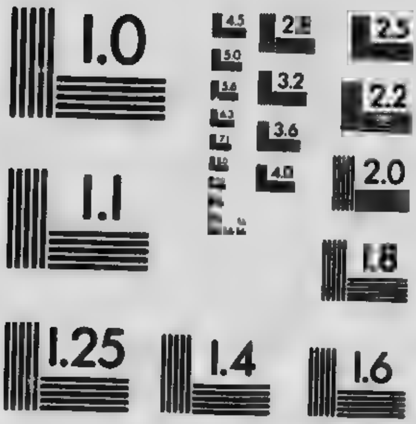

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bases for inference; and quotes the following: That nature abhors a vacuum; that other metals can be transmuted from gold; that all men are equal; that slavery is natural; that all children are born wholly good; that all children are born wholly bad; that in trading the gain of one party is the loss of the other; that dreams are prophetic; that like cures like.[1]

Arguing in a circle is a form of this fallacy which can be seen in any of the frequent attempts that are made to prove the truth of each of two propositions in turn by alternately assuming the truth of the other. Thus a man may assert, "I know my friend to be honest because I feel that he commands my respect and trust, and it certainly must be because he is honest that I feel in this way." "The Koran is true because it is divinely inspired and must be divinely inspired because of the great truths which it contains."

There are circular definitions which belong to this class of errors, as in the example of definition already given: a viceroy is a person exercising vice-regal functions. Here also belong properly those errors into which we are willingly or unwillingly led by the use of question-begging epithets. Business is business, un-British, orthodox, the party of purity,—these are phrases often used in this way. Question-begging epithets are frequently employed in political discussions where the participants are well aware of the value of rallying cries

[1] Welton, Op. cit., Chap. viii.

for their own and opprobrious terms to characterize the opposing party and policy.

In all of the cases cited the error has been due to a mistaken distinction. For example, the phrase "opposed to ethical principles" just mentioned means just the same thing as "morally wrong"; to say that a king is inviolable is just equal to saying that it is unjustifiable to take his life; there is no difference between soporific and sleep-producing. So with the other cases. It will be seen that the fallacy has arisen through failure to identify two phrases which, though differing slightly in appearance, really meant the same thing.

§ 55. **Failure to Distinguish.**—The fallacies we have yet to deal with differ in an important respect from those just mentioned. There we had the specious appearance of inference without the reality. In these as we shall see there is real inference; although there is confusion as well.

If a speaker or writer should find it difficult to prove just exactly the point he wished to prove, but found it possible to prove another point not quite the same though apparently very much like the one he wished to prove, there might enter into his mind the temptation to put forward the second point with all possible force in the hope that his opponent might fail to distinguish the one from the other; and if in the heat of controversy he allowed the temptation to get the better of him he would

be guilty of knowingly employing the fallacy of Irrelevant Conclusion. As an illustration of this we may mention the oft-quoted story of the counsel for the defense in a law suit who wrote on the brief "No case; abuse the plaintiff's attorney." It is chiefly in controversy that this fallacy is successful in imposing either upon ourselves or others, although lack of familiarity with the matter, or with the language used may prevent us from detecting it. "You have often," remarks Crothers, "observed the way in which a person will start out to prove one proposition, and after a little while end up with a triumphant demonstration of something that is quite different. . . . It is a familiar kind of argument. It begins well, and it ends well, but you have a feeling that something happened to it in the middle."[1]

[1] How to Know the Fallacies.—*Atlantic*, Nov., 1906.

PART IV—CONCRETE PROBLEMS OF EDUCATION.

CHAPTER XV.

THE DEFINITION OF EDUCATION.

§56. **Education and Logic.**—Our attitude towards problems of method cannot but be profoundly affected by the definition of education which we finally adopt.

The student of education cannot expect or be expected to frame a definition in vacuo, as the learned sage unacquainted with real specimens of natural history was said to have evolved an elephant out of his inner consciousness. The history of education in the past, the trend of educational endeavour to-day, social and political science, biology, the history of morals, psychology and related philosophical disciplines must all be brought under contribution before an adequate definition can be reached. It would be strange indeed if logic had not something to offer toward the common fund. The work of knowledge is to build up that multiplicity of systems which we call the world. The work of logic is to analyze the process of construction. The work of education cannot be intelligently carried on without taking note of this process. A few considerations will now be put forward bearing upon the definition of education which have been more or less strongly emphasized in the previous chapters.

§57. **Knowledge and Efficiency.**—Among the most prominent features of the case as presented by logic is the fact dwelt upon with some emphasis in the first part of the book that the only reason we have for getting knowledge is that it enables us to do things more efficiently. Knowledge is valuable only in so far as it is a guide to right action. In this view it would seem that a definition of education should be in terms of conduct, rather than in terms of knowledge. This world is not all a bower of roses. If it were, we might perhaps spend our time and surplus energy, if we had any, in finding out about things that do not matter, but as it is we desire to know in order that we may act in such a way as to secure for ourselves what is good and avoid what is hurtful. An attempt was made to show just how our practical and aesthetic interests are related to knowledge getting. The position taken was that we have a purpose over and above the mere knowledge itself. We "want to know" for a very substantial reason. Once more, then, our definition of education must take into consideration the idea of efficiency, ability to execute, to do, and must give to this idea a prominence and an emphasis distinctly superior to that of mere scholarship or learning.

§58. **Education, a Process.**—The ideal of knowledge was spoken of as a systematic explanation of the world. Now one of the marks of an ideal is that it is a long way off. If ideals were of such a nature as to admit of

being actually reached within the limits of our brief span of life, we might, perhaps, look forward to a time or a state or condition in which, having successfully accomplished our investigation of the world, and having so arrived at a systematic explanation of it, we should be ready to meet any emergency, ready to respond to any call for action.

Knowledge, again, is a matter of construction and reconstruction. Not of construction merely, as was mentioned, after the manner of a building or a tool which once fashioned is so made, completed and done with; nor of representation, as if the mind were a glass in which a ready-made world might be mirrored; but one of reconstruction, of fashioning and refashioning, reflection following observation and furnishing to observation new materials to work over.

We saw, too, that knowledge grows—that it illustrates certain laws which are seen to be true of organic life, and that at any time at which we might make, as it were, or imagine to ourselves, a cross-section of an individual's knowledge, it would be found to represent, not a finished product, final, perfect, and complete, but simply a growing structure at a certain stage of its development.

Whatever, therefore, we may mean by the phrase, "an educated man," it is clear that we ought to incorporate within it no idea, or suggestion of an idea, of a state or condition that has once for all been attained. There is an amusing and highly instructive story of a young

gentleman, noted for his convivial disposition and habits, and, as the story proves, possessed, too, of the saving grace of humour, who, on the day of graduation from the University, gleefully waved the bit of magic parchment aloft, and exclaimed in a voice of intermingled exultation, delight, and wonder: "Educated, by Jove!—educated!" As G. H. Locke suggests, we ought to "dismiss the idea of education as a state which, after hard travelling, we reach, and, footsore and weary from our arduous progress upon the road of learning, we contemplate the land of rest—the educational saint's delight."[1]

The efficient individual, at his best, is like an athlete in training for present and future contingencies. He must prepare himself to meet and cope with new difficulties, and adjust himself to new situations. This requires the exercise of constant mental activity, the acquisition of new knowledge, continued reflection and re-adjustment of his ideas. It is clear that our definition should lay stress on the fact that we are concerned here with a process rather than a state.

§ 59. **Education, a Social Matter.**—We have spoken of knowledge getting as a process that is constructive in its character, and noted the fact of the separate worlds in which we live. We have seen that the progress of knowledge seems to consist of a process in which, bit by bit, we acquire and reconstruct into our own systems of

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[1] Education and Social Progress. Proceedings of D.E.A., 1904.

thinking facts at first hand regarding the world of nature, as well as what is handed down to us through tradition, oral and written, and what resides in the customs, institutions and laws, and in the material achievements of the race. We begin apart in the constructive activity of our minds; but every step forward brings us into closer touch with our fellow men and enables us to enter more fully into our inheritance,—to share in the intellectual life and bear a part in the moral struggle. This progress from the self-centred intellectual life of the child towards an understanding and appreciation of the larger life, needs, rights, burdens, and achievements of the race indicates that our definition of education, if it is to be adequate, must recognize that education is a social matter.

§60. Education in Relation to Work and Play.— Moreover we have to consider the whole problem from the point of view of both of the great complementary activities in which human beings engage, namely work and play. We have dealt with the relation of work and drudgery in general and have seen that knowledge is the result of work, and that problems which we undertake to solve because of a real interest in their solution furnish us with a kind of knowledge that is fruitful and abides; while, on the other hand, drudgery cannot do more than supply us with the hollow semblance of knowledge. The type of character which is engendered under a regimen of drudgery is certainly different in

marked respects from that which grows up under a course of work and play. Our definition of education must recognize this fundamental difference and evaluate it.

Summary.—In framing a definition of education some assistance may be derived from logic. That science attempts to analyze the constructive process by which we secure our intellectual inheritance. The analysis of this process reveals certain features which must be considered in any adequate definition of education: conduct and efficiency rather than mere mental accumulation; a process rather than a state or condition; a process of construction and reconstruction and reflection upon our experience rather than one of representation of a supposedly ready-made world; a social matter determined and guided by social needs rather than a purely individual matter for the sake of the individual concerned; the right of the individual to be happy, nevertheless, as well as useful; and the value of alertness and initiative as compared with mere passive obedience to external authority.

CHAPTER XV.

THE PROGRAMME OF STUDIES.

§61. The Problem of Classification.—There are, of course, no Admirable Crichtons nor Lord Bacons nowadays aiming at the acquisition of all our traditional and recorded knowledge, taking all knowledge for their "province." But if educational practice is to take the form of a rationalized endeavour rather than a mere routine, the student teacher must understand that some sort of relation exists between a rational programme of studies and the whole circle of human knowledge; that a programme is intended to represent, not an "odd bite" here and there, but a selection from related fields of knowledge which can be shown to form a whole or system, and for which as a whole and in its parts sound reasons can be offered in the light of the meaning of education.

The problem is thus in part a logical problem. The programme maker must ask himself what there is to select from. He must take some note of the problem of the classification of human knowledge. He will, perhaps, do well to notice first a few of the systems of classification attempted in the past. Bain gives a brief historical account of some of the systems since the time of Bacon.[1] Some of these we shall mention, indicating them in their main outlines.

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[1] Logic, Deductive and Inductive, Appendix A.

Bacon's plan gives a three-fold division into History, Philosophy, and Poetry, corresponding with the three faculties of Memory, Reason, and Imagination. History he divided into Natural and Civil; and Philosophy into three parts, Theology, — Mathematics, Natural Philosophy, Metaphysics,—and the Science of Man.

For the French "Encyclopédie," D'Alembert, in 1750, proposed to follow the same general plan, making some improvements in the subdivisions. In the Encyclopedia Metropolitana, 1815, there were four divisions—(1) Pure Sciences, (2) Mixed Sciences, (3) Applied Sciences, (4) History, Biography, Geography, Lexicography, and Miscellaneous Information.

A few years later in a work entitled "Survey of Human Progress," there were two main divisions, Arts and Sciences. The former comprised mechanical, chemical, physiological, and mental; the latter, first concrete, including astronomy, geography, mineralogy, geology, botany, zoology, history of man, and second, abstract,—physics, chemistry, biology, and mental science.

Later still, Comte in the '*Cours de Philosophie Positive*' begins with mathematics, as controlling astronomy; this is the science of the universe, and includes physics; and under this belongs biology, the science of living organisms, which covers everything from jurisprudence to ethics and from history to aesthetics.

A few years ago Professor Münsterberg wrote an account of the plans adopted for the addresses to be given at the General Congress of Scholars at the St. Louis Exposition, and in explaining the classification decided upon he incidentally pointed out some of the defects of previous and current ideas on the subject. The following represents a later view than that of Comte:—

Physical Sciences { general—physics and chemistry.
particular—astronomy, geology, biology.
formal—mathematics.

Mental Sciences { general—psychology.
particular—logic, ethics, aesthetics.

Münsterberg, in criticising this, wishes to emphasize the idea that life is something more than a series of causal phenomena, and that we must look at the teleological side as well. Life has value, the world has meaning; and he suggests a division of human knowledge into theoretical and practical, theory dealing with facts and values, practice dealing with the relation between facts and ends.

Theoretical:—

(*a*) The world of facts.—(causal view.)

Physical Science.—physics, astronomy, geology, biology, anthropology.

Psychical Science.—psychology, sociology.

(*b*) The world of values.—(teleological view.)

Normative[1] Science.—logic, aesthetics, ethics; and mathematics.

Historical Sciences.—law, politics, literature, education, religion.

Practical:—

(*a*) Utilitarian.—medical, economic, technical sciences.

(*b*) Regulative.—political, legal, social sciences.

(*c*) Cultural.—educational, aesthetic, religious sciences.

The problem, as we have said, is sufficiently difficult, but the student must go far enough into it to realize there is such a problem. He should at the very least try to make out the relation of a few of the main divisions in the above schemes as he will find that he must be acquainted with these distinctions to aid him in the study of a programme for elementary school work.

§62. **Scraps and Specialties.**—The teacher must conceive his programme in no narrow or one-sided fashion. The temper and point of view of the scientific specialist who on his death-bed greatly regretted that in his long life work he had not confined himself to the investigation of the dative case, or of that other whom Holmes designated the Scarabee, should have no place in the schoolroom.

[1] Normative science determines the interpretation of certain facts (philosophy); and exhibits ways of constituting certain relations (space and time).

"May I venture to ask,—I said, a little awed by his statement and manner,—what is your special province of study?

I am often spoken of as a Coleopterist,—he said,—but I have no right to so comprehensive a name. The genus Scarabæus is what I have chiefly confined myself to, and ought to have studied exclusively. The beetles proper are quite enough for the labour of one man's life, etc., etc."[1]

As a matter of fact specialists of this extreme type are constitutionally unfit for teaching except in graduate schools, and ought to be kept under careful supervision even there.

The elementary teacher, then, must not lose his sense of proportion. He must try, at any rate, to preserve his balance as he looks at the programme of studies. The odds are enormously against the average teacher, who, of course, is likely to be as lob-sided as anyone else, according to the conditions under which he himself was taught. But he can at least try to conceive his programme as a system each part of which stands in a necessary relation to every other, not in an accidental relation depending upon the arbitrary likes and dislikes of the teacher whose business it is to administer it.

Not only must the teacher conceive his programme as a systematic whole; he must keep clearly before his mind, at each step, the relation in which the present

[1] The Poet at the Breakfast Table, Chap. ii.

lesson, in the ordinary day's work, stands to the department of study to which it logically belongs.

A man in charge of a school once saw a machine used by a farmer to cut up food for cattle. A surprising variety of roots, vegetables, and what-not went into the machine and came out at the other end, cut up fine, and ready for the animals to eat; and they did eat, and waxed fat. Now, the teacher was anxious to do his best for his scholars, and, thinking that he was on the track of analogy, began to give a series of lessons which he called "miscellaneous information lessons." He collected material from every source at his command. He reduced it to the smallest possible form—to single sentences, most of it. And he "gave" it to his pupils at the rate of so many "facts" per diem. There was naturally not the smallest appearance of connection between one "fact" and another. One would bear upon Bible history, another upon crime in the Congo, another upon Canadian trade with Britain, another the derivation of a word, or some wisdom about microbes, or heraldry, or the distance of a star. The result of it was that his pupils acquired a considerable deal of curious and very miscellaneous "knowledge."

It will not be necessary to offer any criticism of this kind of procedure. The student can readily do that for himself; and the reasons which he will urge against it may be found useful later on, when in his own teaching he finds himself transgressing in very much the same

way. It is particularly easy to fail just here. There is probably no blunder more frequently made in the schoolroom than that of failing to conduct lessons systematically.

The failure in system may take place at several points. We may fail, as has been said, in the degree of emphasis and the amount of time devoted to any given branch. But, again, within the limits of a single branch we may fail to present matters in such a way that the learner can discern the broad lines of connection running through it. To-day's lesson may not be seen to grow naturally out of yesterday's and to-morrow's may not be definitely related to either. The case of the teacher whose work is of this unsystematic character is not much better than that of the man in the story just related. Very frequently it is no better.

The lesson which is not a systematic whole in itself is of such frequent occurrence as to merit special notice. It is easy to recall or imagine lessons of this kind. The teacher asks a few questions in a mechanical way about topics that happen to come into his mind, mentions a circumstance, gives some statistics if possible, relates a little story, and there you are. Geography and history lend themselves very readily to this kind of treatment.

Where is India? In Asia. What part? South. Any rivers in India? Ganges, Indus, etc. Climate? Hot. (Stories of heat by the teacher.) Religion of the natives? Buddhist, Mohammedan, etc. (More stories.

Juggernaut. Thugee.) Mountains? Himalaya, etc. Population of India? So many millions. Government? British. (Stories of the Mutiny to end of lesson period.)

No one can have any valid objection to a bright, lively, illustrative manner of conducting a lesson as long as the lesson leads somewhere. It is of course possible to state an isolated fact in a very striking way so that from its very oddity in idea or expression it may conceivably become a centre about which other facts may be gathered to form a coherent system. What the beginner is warned against here is the utterly unsystematic character of this kind of "lesson," which leaves the learner to correlate as best he can the various items of information that happen to come his way. Enough has, perhaps, been said upon the nature of knowledge as tending to the building up of system to enable the student to see that scrappy and unrelated lessons and purely miscellaneous information are of very doubtful value.

§63. **The Problem of Educational Values.**—*The Three R's.*—The modern elementary teacher is apt to look back with a certain envy to the happy lot of his predecessor, whose labours were confined to three or four staple "subjects" of study. Not very long ago the present bulky programme consisted of reading, writing, and arithmetic. The newer "subjects" as they were successively added were opposed and denounced as fads and frills by the educational conservatives of the

day. However, the course of study grew; and it grew in response to social needs, and in the face of opposition offered by pedants within and without the schoolroom. The history of school programmes in the state of Massachusetts, the home of the common school on this continent, furnishes us with an excellent illustration of how programmes grow.

We are, perhaps, apt to think that there is something eternally valid and sacrosanct in a course of study, particularly if we have gone through it ourselves. We are apt to feel that any impeachment of that course of study is in a sense an impeachment of our own intellectual and perhaps moral integrity. We ought to get accustomed, as soon as possible, to the idea that programmes, whether in school or college, possess no such validity, but are in constant need of revision and reorganization. Geography, for example, was made a compulsory subject of study in the schools of Massachusetts in the year 1826, in an era of expansion, during which near a dozen new states were added to the union, and international relations began to have a meaning. The large influx of foreign population, ignorant of American traditions, during the fifties, and the anti-slavery agitation at the same time, involving great constitutional questions, made it necessary to add history in 1857. The superiority of European manufactures in the Paris Exposition in 1867 startled the business men in the state into petitioning the legislature for compulsory

instruction in industrial drawing, and this was added in 1870. For similar reasons manual training was added in 1884, and made compulsory in 1898. The old colonial course, prior to 1789, consisted of reading and writing. English grammar and spelling and arithmetic were added after that date.

Many of us, again, are inclined to look upon reading, writing, spelling, and ciphering, as "subjects" of study possessing a real and final value of their own, and standing in a class by themselves. They are by many considered as the peculiar and appropriate fruit of elementary education. To be able to write a clear, legible hand, to spell well, to pronounce all the words on the page properly and distinctly, to do sums smartly and accurately,—these are the points upon which many insist as being especially worth aiming at. Other results are all very well in their way, but the three R's are fundamental and the other "subjects" are accessory. In this view the only justification of the other and "newer subjects" is that they furnish recreation in the intervals between the periods devoted to serious study. And so the true function of the primary school is to put the young in a position to take their places as members of civilized society by furnishing them with the key to the treasure-house of knowledge. It teaches reading and writing, a working knowledge of certain symbols which stand for ideas in human records. It teaches arithmetic, and so supplies a labour-saving system of shorthand calculation

which relieves him of the necessity of counting. The tedium involved in acquiring these arts, school arts as they have been called, may be relieved, as already said, by various devices such as the judicious employment of literary, musical, and pictorial art, with a small admixture of history and geography. It is frankly recognized that these "accessory subjects" may in themselves prove not unfruitful of result, seeing that by them one may gather some miscellaneous information; but the serious business of the primary school is held to be the cultivation of certain mechanical arts, reading, writing, and ciphering, which prove useful later on.

The foregoing theory is held by a large number of those who support the schools as well as by many of those who are at work within them. Our present schoolroom conditions, with classrooms filled to their utmost seating capacity, our carefully graded classes, fixed courses of study and limit tables, and our schoolroom furniture suited as it is for reading, writing and figuring, have all been formed and framed by this notion of what the schools ought to aim at.

In radical opposition to all this is the idea that regards the acquisition of skill in the "school arts" as incidental to a larger design: that true education means a great deal more than mere facility in the use of the tools of learning; and that manual training, the study of real literature, an appreciation of music and other fine arts, an acquantance with nature at once sympathetic and

intelligent should come within the scope of school effort, and that these studies should not be regarded as occupying a place on the programme merely on sufferance, or as affording occasional relief from the burden of more serious matters, but as furnishing effective and definite preparation for social duties by ministering to certain imperative spiritual needs.

Those who set before themselves the latter aim endeavour to show that the division of school studies into two kinds, necessary and ornamental, is an entirely erroneous one. They hold that the school arts are valuable only in so far as they help towards the acquisition of real knowledge. They believe that the two groups should not be thought of as standing in a quite external relation to each other, but that on the contrary there is the possibility of an organic connection between the arts which afford the necessary aids to the getting of knowledge, and certain other instrumentalities bearing upon the present needs and nurture of childhood; and that the primary school can perform its true function only when it makes the personal development of the child its first and peculiar care, and regards the acquisition of skill in the school arts as incidental rather than final.

Formal Discipline.—It used to be, and to some extent is yet, the fashion to account for the presence of a given subject on a school course in the following manner. There are various faculties in man, it was said, which

may be developed or trained, and for the development of which certain branches of human knowledge are especially suitable. Thus, if you desire to develop your reasoning power, they say, you are to pursue this branch of study, whereas if you wish to improve your faculty of memory you must devote yourself to that one, and again for the growth of your faculty of imagination another and different study is to be chosen. Mathematics, in this view, is said to be good for the reasoning faculty, poetry an excellent thing for the imagination, and history just what is needed for the memory, while for the person whose faculty of observation is to be strengthened nothing is better than a course in natural science. And so by a careful choice of topics or subjects of study it was thought possible to secure an all-round development of the human 'faculties.'

That this whole argument is fundamentally unsound need not prevent us from recognizing any elements of truth that it may contain. It will be quite readily admitted that a man who uses his brains in studying mathematics, or natural science, or languages for any considerable period, will be found, in the course of time, to have acquired power and skill wholly wanting to the man who has lived a life of mental idleness. But are we entitled to go farther, and say that a course of studies ought to be selected with exclusive reference to the training of faculty, in the hope that when so trained it

may prove adequate to the accomplishment of the tasks and the solution of the practical problems of life?

It is difficult to say to what extent this idea finds support in the minds of those who advance it in the definition of education as the "harmonious development of the human powers"; or in the description of mind as a collection or assemblage of faculties, each with its own special work to do, one faculty remembering, another imagining, a third reasoning, and so on. But there does seem to be involved here the assumption of a mental "power in general," capable of being developed by mental activity in a given field, stored up for future use, and drawn upon at need for use in any other field.

Passing by this vague and inadequate definition of education, and the obsolete theory of mind spoken of, we may devote a word or two to the doctrine of formal discipline, as it is called.

Those who uphold the doctrine of formal discipline, say that the pursuit of certain studies in school or college will fit a man for the pursuit of any study; that a student who has taken a course, for example, in mathematics and the so-called dead languages, has, in the process, stored up power in general which is immediately available for the study of economics, or natural science, or politics, or ship-building.

A more modern opinion, however, declines to believe in the existence of any such power in general as has been mentioned. It is held, on the contrary, that a man

may be an excellent observer in one field and a very poor observer in another, or possess a good memory in matters of science and very little for real estate values or political happenings. There may be, it is true, a "power in general" in the sense that power gained in a certain field enables one to judge promptly and accurately *in a related field* where the matter and the point of view differ but slightly. There is, properly speaking, a specific power of judging which depends upon the nature of the subject matter, a power which asserts itself in that particular field or in closely related fields. Acquire one language and it is not so difficult to acquire a second. So of other branches. But one may develop "an eye for an equation," or an ear for a well turned phrase, and afterwards prove quite blind and deaf to a fallacy in a philosophical argument. Of course men may and do possess ability in two or more widely different regions of knowledge, but this does not mean that power to judge in the one class of cases was developed through judging in the other.

In one of his educational essays Mr. John Adams suggests the following as a test of the effect of this general kind of training. "Accepting for a moment the popular view that the mind can be trained by any subject whatever, with the limitation that certain subjects are better for training purposes than others, let us see how the thing works out. Take three men, one trained as exclusively as possible on the Classics, another on

Science (say Biology), and the third on Mathematics. To test the effect of the training, a problem is set to all three, –the same problem." But there is difficulty at once about the test. The first one suggested is to decipher a certain hieroglyphic inscription. The mathematician joins with the biologist in objecting that this gives an undue advantage to the classic, because although the inscription is neither Greek nor Latin it is at least in the line of language. The next suggestion is to determine the age of a given stratum of rock. But this does not suit the classic, who joins with the mathematician in pointing out that although this is not exactly biology, it is in the biologist's line. The third test proposed is to discover how in the minimum of moves to place the knight on every square of the chess board. To this the mathematician offers no objection, but the others do. A fourth test is proposed, namely, to find a lost will. Of the three the classic seems the most likely to succeed, but if it is really "important to find the will we send for an experienced lawyer. It is not maintained that this lawyer has a better trained mind than our three friends, but he has a bigger and better-arranged lost-will apperception mass."[1] Or, as we might say, he can judge more readily within that kind of system.

Subjects of Study as aids to Social Service.— Teachers in elementary schools nowadays generally carry on their work in accordance with the principle we

[1] In the Volume on the Herbartian Psychology, p. 198.

are here advocating. The principle is not in all cases followed out to its final conclusion, but it is recognized, and its influence now suffuses the atmosphere of most of our primary schools.

In reading, for example, the purely formal work of an earlier time which comprised the learning of letters, syllables, and words, along with hopelessly uninteresting and almost meaningless sentences is hardly ever seen nowadays. Instead you find beautiful books full of interesting stories and poems,—real literature with fine pictorial illustration: and the beginner regards this matter of learning to read as a problem that he himself is interested in solving for the sake of the good things that he will by that means be enabled to enjoy at will. Partly as cause, and partly as consequence of this we see that oral reading is treated as a real means of expression of thought and feeling. There is a vast difference between a mere correct pronunciation and proper enunciation of the words on a printed page on the one hand, and the adequate expression by the voice of the thought and feeling embodied in those words. And this vast difference corresponds to the difference we are here emphasizing between these two opposed theories. One of these theories seems to involve the idea that there is no necessary relation between the acquisition of the tools of knowledge and the use of these tools in the interest of one's present needs and growth in grace. The other theory distinctly states that the learner has needs to be

administered to now, and that the best use to which these tools of knowledge can be put is that of actually getting knowledge to-day, suited to the needs and aspirations of to-day.

Writing, in like manner, is no longer treated as a wholly mechanic exercise undertaken with a view to future contingencies. The modern teacher looks upon the small boy or girl as having ideas to express, and as being worthy of such training as will enable him to express them in the most effective manner possible. Indeed, it is because the boy is an undeveloped being that such consideration is his rightful due.[1]

The teaching of arithmetic has not perhaps advanced as rapidly as the other two staple subjects; nevertheless some progress has been made. It was once thought desirable to initiate children into the mysteries of arithmetic by the use of huge "sums" involving rows of figures in billions and trillions. That is largely a thing of the past. Small numbers nearer to youthful comprehension are now employed. Children were once expected to believe, on the authority of teacher or text, and to remember that nine sevens make sixty-three. Nowadays they are expected not only to remember this as a statement of numerical truth, but also to be able to prove

[1] Professor Dewey in "Psychology and Social Practice," *Chicago Univ. Press*, says that from the standpoint of psychology and biology the difference between the child and the adult is that the former "is or should be busy in the formation of a flexible variety of habits, whose sole immediate criterion is their relation to full growth, rather than in acquiring certain skills whose value is measured by their reference to specialized technical accomplishments."

it, and, more important, to use it. The memorizing of rules, the solution of abstract problems, highly ingenious puzzles, tricks, and catches, the antiquated systems of weights and measures which formed so large a part of books on arithmetic a generation ago have given place to concrete problems closely related to child life. It is true, the formal and abstract have not been completely eliminated. But progressive teachers are more and more inclined to look upon arithmetic as a branch of knowledge which can best be mastered not by treating it as an end in itself, but by making use of arithmetical ideas in the accomplishment of some other end. Actual measuring of lines, surfaces, and solids, with insistence upon accuracy, and calculation of real quantities with a definite purpose in view, are found to be much more effective in furnishing the beginner with a working knowledge of arithmetic than an indefinite amount of practice in formal rules with abstract numbers or even with imaginary problems not related to the pupil's actual experience.

Formerly the teacher would select in a somewhat random way, from a text-book, something like the following:—Find the cost of painting the walls of a room 25 feet long, 20 feet wide, and 10 feet high, at 20 cents per square yard. To-day, the more considerate teacher, if he were to propose a question of that kind would be provided with an excellent excuse for doing so just at the time. It would

naturally arise at a moment when the pupils were interested in some live question or problem in which painting was concerned. The question would probably take some such form as this: What would it cost to paint the walls of *this* room? The teacher, if he is prudent, will leave the matter to his pupils at that point. They are just as well able to hunt up the particulars as he is to furnish them. There is an air of reality about a problem like this which does not belong to book questions. The pupils, as already said, have a purpose in view, some larger purpose to which this matter is related as part to whole, or as an illustration, or what not. Guided by this purpose they go to work with measuring rods to find out the surface to be covered. This requires accuracy. Also there are questions relating to the cost of painting materials, oil, etc., and the cost of labour required, which the pupils would be expected to find out for themselves if possible. In brief, the attitude of the pupils towards a question of this kind should, as nearly as possible, approximate to the attitude of a man who has an actual room requiring actual paint, and who is concerned with the question of actual cost. "The test of teaching," as Adams remarks, "is not how the master teaches, but how the pupil learns. The true method is to break up each complicated problem into a series, not of propositions, but of little problems,—not judgments to be made, but ends to be attained."[1]

[1] Op. cit., p. 104.

There are difficulties in the way of creating within the schoolroom an atmosphere of reality to take the place of the artificiality and remoteness from life which is the chief bane of many of our educational institutions to-day. As we have already mentioned, most of our schools have been built, laid out, and furnished with mere form of reading, writing, and ciphering in view. That is to say, the conditions surrounding the teacher's work in our schools as they are organized to-day are favourable to the teacher who is willing to confine his attention to furnishing his pupils with the tools of knowledge. The teacher who desires to do more than this, who desires to create within the school a real, typical, social world is hampered by conditions which were secured for the working out of the other theory.

As to the value, then, which ought to be placed upon the three R's in our school programmes of study, the ground taken here is that the process of education is or ought to be a process of participation in life, a life that is found to be full of problems awaiting solution. The solution of these problems incidentally requires the solution of others which include the deciphering of records, the recording of facts and ideas, and the calculation of quantities and numbers. Learning to read, write, or cipher is simply to be regarded as incidental to a large social purpose.

It should not be necessary to add that mere preaching by the teacher upon the ultimate utility of this, that, or

the other art or study is not what we have in mind here. That is a device which has been employed by teachers in all ages in a usually hopeless attempt to get their pupils to study something outside of the range of their interests. Young people yield a ready *intellectual* assent to abstract arguments of this kind. But what is wanted at this stage is that the learner shall *feel* the need of getting possession of this bit of knowledge in order to be able to use it at once in carrying out some purpose that he has formed; not merely that he shall discern dimly, as in a mist, and with cold indifference, devoid of interest or care in the matter, that, "yes, perhaps, some time, information of this kind might, somehow, turn out to be of use to somebody, perhaps to me,—who knows?"

The question of the special method of teaching any subject cannot be decided apart from the question of its educational value; which in its turn can only be determined in view of the aim of education: and therefore, broadly speaking, if we adopt the socializing function of education as the true one, our conception of the value of any given branch or group of studies and its treatment in school will be dominated by the idea of education for social service. The influence of this idea will make i self felt throughout all the daily lessons in all classes.

Wherever this view of education prevails, reading cannot be regarded as "fundamental" except in the sense that a key is "fundamental" in relation to a house that you want to get into. Language is the instrument

which makes society possible, hence the value of reading which leads to literature, a branch which must be thought of by the teacher as furnishing practical, moral, and aesthetic training for social service. It leads to grammar, which gives us an insight into the nature of human thought, and the intellectual life we share in common. In all our study of history the social aspect will come in for a greater share of emphasis than has been usual. If we are to learn from the experience of the past what to do and what to avoid in our future social arrangements, history must be studied more and more with reference to social causes and results, and less with reference to the mere pageantry of court and camp. Geography may be made to arouse social consciousness, and to give to the learner an understanding of and a feeling for the intimate and necessary social and economic relations existing among the tribes and nations as well as between individuals. Manual training should not aim merely at skill in the use of tools as an end in itself, but should be carried on with direct reference to the social view of education. In the earlier days of manual training there was a great deal of emphasis upon "skill." Pupils were set at driving nails straight, planing boards, making close joints, learning how to handle a saw, and the privilege of making things was denied to them until some "skill" had been acquired. Better counsels are now prevailing, and the student acquires skill not by setting skill before

him as an end, but by using tools for the purpose of making something useful from the materials within reach, thus satisfying his own inner need of objective expression and at the same time taking a part in the social life about him.

Summary.—Topics for study on school programmes should be selected so as to ensure a fair representation of the great divisions of human knowledge at every stage of progress; and the selection should be made on a practical and objective social basis. The modern teacher recognizes this basis of selection to-day by treating all branches of knowledge as aids to awaken social consciousness and to fit for social service.

CHAPTER XVII.

WORK, PLAY, AND DRUDGERY IN SCHOOL.

§64. **Interest,—Real and Artificial.**—When school programmes are conceived and carried into effect, not with a view to the present practical and aesthetic interests of the learner, but with an eye single to certain interests which may dominate his life later on, it is extremely difficult to find a point of contact between the learner and the subject-matter of instruction, for the simple reason that although this subject matter has been conceived by adult minds in the course of their experience, and has been by them adorned and invested with a sort of halo of eternal validity as objective truth, it cannot at this stage be so conceived by young people whose lives are filled with other and different interests.

There are two ways along which schoolmasters in all ages have tried to lead the young towards "knowledge" of the kind spoken of. One is (confessedly) a painful way; the other is (rather boastfully) described as one of pleasure. These are the only roads that are open to the teacher whose programme of studies has been laid out with reference to a learner's future, instead of his present and future needs. Which road shall the teacher choose? The answer will depend a good deal upon his disposition. The most consistent upholder of the school of drive and force will not, upon occasion, refuse to allow his flock the indulgence of a saunter along the flowery

path, wherever it lies convenient to his chosen route. This, however, he will regard as a happy accident, or will permit it merely as a concession to human weakness. It must be admitted on the other hand that the task of making all rough places smooth, of providing new delights for their charges proves a severe trial indeed for the exponents of the pleasure theory, and now and then under pressure of weariness,—for the sated young pleasure-seeker demands a stronger and ever stronger stimulus for his pampered and jaded appetite,—and occasionally in response to a demand for results,—for the public want measureable results,—the teacher hardens his heart, and leaves the rose-strewn path for a little while.

It is easy to find fault with both of these theories of teaching. But it is not easy to suggest anything better as long as the "knowledge" which we try to impart is out of relation to the learner's present needs.[1] At bottom these apparently opposed systems are in reality alike in that the end proposed is determined by an external authority and not sought or adopted by the learner. Where the latter identifies himself with the plan of action or of study proposed all goes well; neither force nor coaxing is necessary. But when he forms no plan for himself, or fails to adopt the plan proposed, your only choice is to drive him or coax him or alternately drive

[1] See Dewey's "Interest in Relation to Will," Year-book of the Herbart Society, 1896, in which this subject is fully treated; also "The Child and the Curriculum," *Chicago Univ. Press*, 1902, by the same.

and coax. The two plans are thus alike in that the appeal is to an artificial rather than to a natural interest. In a real sense, of course, it is "natural" for a boy to avoid pain or to seek pleasurable excitement. But it is also fair to say that the connection between sugar plums or stripes and a geography lesson is as distinctly artificial as anything can well be.

There is no middle course towards this goal, except in so far as the plan of alternate stripes and sugar plums constitutes a middle course. If school studies are not intrinsically interesting, they must be "made interesting," or the pupil will have none of them.

§65. Types of Educational Practice.—1. *The School of Drive and Force.*—We find that there are three schools which are conducted on the plan of *making* things interesting. There is the school of drive and force. Here the teacher believes that drudgery is a good thing, that it puts backbone into a boy to be *forced* to do things that he detests. If a boy shirks the drudgery or rebels, the teacher *makes* it interesting for him. As Dewey says,—"To learn the lesson is more interesting than to take a scolding, be held up to general ridicule, stay after school, receive degradingly low marks, or fail to be promoted. And very much of what goes by the name of 'discipline,' and prides itself upon opposing the doctrine of soft pedagogy and upon upholding the banner of effort and duty, is nothing more or less than just this appeal to 'interest'

in its obverse aspect—to fear, to dislike of various kinds of physical, social and personal pain."[1]

2. *The School of Coax.*—Differing sharply from this, not in aim and purpose, but only in the means to be employed in reaching it, we have the school of coax and amuse. Here the teacher believes that drudgery is a bad thing, that it makes a boy dull and stupid and often sullen to be forced into an occupation or task that he dislikes, and that the proper plan is to coax him, and amuse him, and give him a pleasant time of it and so entice him into the path of knowledge. While this school differs from the school of drive and force in that it aims at being easy and not strenuous, the two resemble each other as we have said in that for the pupils in both cases the problems and materials for study are selected beforehand by authority. "No one seriously questions," to quote Dr. Dewey,[2] "that with an adult, power and control are obtained through realization of personal ends and problems, through personal selection of means and materials which are relevant, and through personal adaptation and application of what is thus selected together with whatever of experimentation and of testing is involved in this effort." In the school of amusement and diversion, as well as in that of drudgery, these conditions of increase in power which are requisite for the adult are denied to the child.

[1]The Child and the Curriculum, p. 37.

[2]Psychology and Social Practice, p. 13.

3. *The School of Alternate Drive and Coax.*—Then there is the middle course which was spoken of a little ago. There are teachers who are too much in earnest to allow the school occupations to drift wholly into entertainment and pastime, and too good-humoured to insist upon continuous drudgery. These form a considerable class representing the school of alternate drive and coax.

It is no doubt true that students in very many cases make real progress, exercise real, forceful activity without appeal to either fear of pain or love of pleasure. But such results are pure accident as far as the types of educational theory and practice under consideration are concerned. In such cases the learner's progress is due to the fact that he has formed a plan for himself or adopted one suggested by some one else,—a plan the carrying out of which appeals to his personal, practical interests and present needs. The type of educational practice which we are considering at the present time is that based on the idea that a programme of studies should be laid out with reference to the learner's future interests as its main foundation, the subject matter being "fixed and ready-made in itself, outside the child's experience." It may frequently happen that the learner finds a point of contact with this subject matter, and it so becomes possible for him to apprehend and assimilate it to his own experience in a real sense. But, no thanks

to those who made the programme; for that result was not contemplated in their theory.

4. The School of Work and Play.—Finally there is the school of work and play. From this school, as far as is possible in this imperfect world, both drudgery and dissipation have been shut out. The programme is the pupil's programme just as much as it is the teacher's. There is therefore a true interest in the daily work.

The road to knowledge here laid out is a much better road than either of those described in the preceding paragraphs. It is a road which is at once pleasant and difficult. There are difficulties to overcome, the mastery of which the learner consciously and deliberately sets before him as an end, as something necessarily involved in the carrying out of a plan of action. And there is satisfaction in such effort and achievement. This is the road to real knowledge. Any one who travels this road will refuse to be satisfied with the bare symbol of a fact; he will search out the fact itself. In such a case the programme will have been conceived with a view to the present needs and interests, practical and personal, of the learner, and will be regarded by the learner as his own.

§66. **Research in Education.**—There are two contrasted types of education, and by consequence two contrasted types of educational product.

In the one case you have what may be described as the docile and obedient individual modestly and unquestioningly receiving at the hand of his teacher,

a traditional stock of knowledge furnished by the schools and bearing the stamp of their approval.

On the other hand you have the individual who is inclined to make plans for himself rather than acquiesce readily in the plans of others, active and resourceful rather than obedient, enquiring and alert rather than docile.

The latter type of pupil while he may not be quite satisfactory to the schoolmaster who has a cut and dried programme set out is much more likely to be heard from later on, to achieve a real success in life, than the former. If we are right on this point there can be no doubt of the wisdom of the advice offered by a strong advocate of a practical purposeful course of studies who says that we ought to "lead children to see that they are not engaged in learning isolated lessons, but working to a desirable end—lead them, in fact, to take a real interest in their school work, and acquire the habit of working without compulsion. It must be no longer a reproach to us that, as Thring puts it—'The school-boy alone is turned loose into the working world without the smallest idea of what he is about or how to work.'"[1]

The term 'research' makes us think of laboratories and libraries where there are "experts," and learned men who are engaged in a serious endeavour to solve intricate historical and scientific problems, and whose

[1] Armstrong, The Teaching of Scientific Method, p. 200.

achievements in their respective fields constitute a real advance in human knowledge. When we speak of methods of research in elementary and secondary schools we are certainly not using the term in this sense. No one proposes that boys and girls shall be set to investigate the habits of a new microscopic germ or to examine original documents bearing upon King Henry the Eighth's theological opinions.

Research in primary education is no new thing.[1] Teachers in all times have employed the method on a larger or smaller scale. There have never been wanting in the ranks of educational workers, men who could see clearly that children and adults are precisely the same in their attitude towards the solution of problems that interest them, and whenever teachers have possessed this degree of insight their pupils have experienced the joy of finding out things by their own efforts. There have always been some teachers who knew that you

[1] Dugald Stewart, writing on the "Active and Moral Powers of Man," Chapter ii, says: "there is no circumstance of greater consequence in education than to keep the curiosity always awake, and to turn it to useful pursuits. I cannot help, therefore, disapproving greatly of a very common practice in this country, that of communicating to children general and superficial views of science and history by means of popular introductions. In this way we rob their future studies of all that interest which can render study agreeable, and reduce the mind in the pursuits of science, to the same state of listlessness and languor as when we toil through the pages of a tedious novel after being made acquainted with the final catastrophe. . . . . Such a mode of education, too, would be attended with the additional advantage of accustoming the student to the proper method of investigation; and thereby preparing him in due time to enter on the career of invention and discovery. Nor is this all. It would impress the knowledge he thus acquired, in some measure by his own ingenuity, much more deeply on his *memory* than if it were passively imbibed from books or teachers; in the same manner as the windings of a road make a more lasting impression on the mind, when we have once travelled it alone, and inquired out the way at every turn, than if we had travelled along it a hundred times trusting ourselves implicitly to the guidance of a companion."

can get more real work out of a boy, more effort, more brain activity, and more hearty human response by the suggestion: "Here is a problem that you might try to solve. I think you are man enough for it. In order to manage it you will have to look up certain information in such and such books, you will have to go and observe certain matters for yourself and make certain experiments and measurements,"—than by the command,—"learn that page or chapter and prepare to recite it to me."

The attitude of mind which real problems call for is one of enquiry and keen determination whether the enquirer be young or old. The actual gross amount of knowledge that one accumulates by the way in the course of solving a real problem is astonishingly great compared with what is gained in the learning of isolated lessons under the tyranny of the book. Careful observation and close inference go with research both in the juvenile and in the adult—intellectual habits which do not seem to belong naturally with the mechanical learning of lessons out of books.

Summary.—There are two kinds of interest, intrinsic and artificial; two kinds of schools, those where work and play are considered legitimate occupations and those where drudgery or dissipation or both are admitted; and at least two kinds of educational product, the active, enquiring, and alert individual, and the passive, obedient, acquiescent, and docile one.

QUESTIONS AND EXERCISES.

PART I.—THE GENERAL NATURE OF KNOWLEDGE.

CHAPTER I.

THE IDEAL OF KNOWLEDGE.

1. Distinguish the uses of the word phenomenon in the phrases 'a phenomenal yield of wheat,' 'natural phenomena.'

2. Give some illustrations of the difference between a phenomenon and its meaning or significance.

3. Does the derivation of the term 'system' suggest its meaning?

4. Mention what you take to be the essential feature of a 'system.' Illustrate.

5. Show that the term 'system' may be applied to objects in space as well as to plans or ways of doing things.

6. In a 'system' you can tell from some of the parts what the others *must* be. With this definition in view show what would be necessarily involved in getting a 'systematic' knowledge of the following: any machine or tool, say a bicycle; a dwelling house; a factory; a ball game; a game at cards; a plan or way of making a cake or pudding; the meaning of the term 'cube,' the term 'circle,' the term 'six,' the term 'river system'; the Mississippi river system; the Seven Years' War.

7. Show how the idea of explanation as systematic will guide you in expressing thought either orally or in writing. Show further how the idea of 'system' will help you in teaching composition.

8. A proposes to learn a list of rivers as so many words. B having an idea of the way river basins are formed looks for the relation of each river to the whole continental system. Compare A's knowledge with B's.

CHAPTER II.

KNOWLEDGE AND PRACTICAL INTERESTS.

1. Is there any necessary connection between the number of one's interests and the extent of one's knowledge? Illustrate.

2. Give an illustration or two to show that there is an element of purpose in our ideas.

3. Are you conscious of any difference in the kind of pleasure you get from taking part in a ball game and that which you experience in watching others play?

4. What do you take to be the distinguishing feature of play as contrasted with work? Of the latter as contrasted with drudgery?

5. Drudgery is said to result in a habit of oscillating or divided attention. Illustrate.

6. Make an estimate of the amount of time you spent at school in work, play and drudgery respectively.

7. How does this last compare with the way grown-up people spend their time?

8. In what branches of study did you excel at school? How were they related to your practical, aesthetic and personal interests?

9. What steps did your own teachers take to "lighten the drudgery" of school tasks? Was school drudgery ever elevated to the plane of work?

10. What do you think of the theory that skill in the practice of any art—useful art or 'fine' art—is most readily acquired when undertaken and carried forward under the influence of and in the spirit of play, and that 'practice' is time wasted when it is felt to be drudgery?

CHAPTER III.

KNOWLEDGE AS CONSTRUCTIVE.

1. How will you illustrate the statement that knowledge does not come to us ready-made?

2. "Our senses give us merely the materials out of which we construct." Explain this statement.

3. What do you object to in the statement that the mind is like a mirror?

4. What do you mean by such phrases as the world of science, the world of work, a narrow world?

5. What guides us in our work of mental construction?

6. A student recites a lesson in history in the exact words of the text. Another gives an account of the transactions of the period in his own words, making comparisons with similar transactions in other periods. Which is better, and why?

7. A makes a box, taking all his measurements from a ready-made model before him. B has before him his own drawing of a box which was designed by himself. Which is better for the student? Why?

8. Give illustrations from your own experience in the study of natural science, to show the uselessness of

looking at specimens of natural history, or watching experiments, in an aimless way.

9. Show how observations and experiments should be conducted.

10. 'A school should do more than merely reflect existing civilization.' Explain.

CHAPTER IV.

KNOWLEDGE AND GROWTH.

1. Distinguish between the point of view of 'construction' and that of 'growth' in knowledge.

2. A house is spoken of as a mechanical system, a plant as an organism. Explain these terms.

3. What are the chief points of likeness and difference between a clan or tribe and a nation, between a canoe and an ocean liner?

4. What are the chief differences between the mind of a child and the mind of an adult?

5. Mention an illustration or two of the way in which new relations in knowledge are established.

6. Give as clear an account as you can of the system corresponding to the word 'king' in the mind of a boy and of a man respectively.

7. Do you experience any difficulty in 'making children understand'? To what is the difficulty due?

8. Show that increase of knowledge is an increase of complexity rather than of bulk or quantity.

9. Comment upon the statement that a small amount of well articulated knowledge is more valuable than a large amount of loose and fragmentary information.

PART II—JUDGMENT AND INFERENCE.

CHAPTER V.

JUDGMENT, THE FUNDAMENTAL FEATURE IN ALL THINKING.

1. What distinctive element or feature is to be found in the thinking process at every stage of advancement?

2. What is meant by saying that judgment is an act of interpretation?

3. If the general idea of growth, the evolutionary view as it is called, is accepted, are we entitled to say that perception, memory, imagination, and inference are separate intellectual processes?

4. Assuming as correct the account of judgment which identifies it with the *response* to a *stimulus*, which of these corresponds to subject and which to predicate?

5. How may judgment expand or grow into an inference. Illustrate from the study of geography or history.

6. Show how the study of grammar may furnish an introduction to logic, and give one an insight into the nature of thinking.

CHAPTER VI.

THE NATURE OF JUDGMENT.

1. Show from the nature of 'system' what is meant by the statement that every judgment has a ground.

2. What is meant by the following:—The witness was *compelled* to admit that so and so was the case.

3. What do you mean when you say, 'I rely on the *evidence* of my senses?' Do the senses give you the fact, or merely evidence for the fact?

4. How do you distinguish the concept from the judgment?

5. A story may hang together, and yet not agree with the facts. Is this possible?

6. Mention some of the questions which may be asked regarding judgment as instrumental. What guides us in using this tool? How do we know when it has done effective work?

7. We are warned to avoid confusing analysis and synthesis with the physical process of breaking a thing into parts and putting the parts together. Explain.

CHAPTER VII.

TYPES OF JUDGMENT.

1. What do the naturalists mean by a 'type'? Do they mean a group of forms bearing a set of characteristic marks quite easily distinguishable from another characteristic set belonging to another group close to it? Are 'types' in any sense artificial? Explain.

2. How does the Categorical judgment differ from the Hypothetical?

3. Classify:—The cows are in the corn; The roads are impassable; Men are mortal; They hang horse-thieves in that country; The Russians are patriotic; Trespassers will be prosecuted; That is neither ornamental nor useful; Water freezes at 32°.

4. Failure to understand a lecture, demonstration, discourse, or lesson is sometimes due to the fact that the speaker utters hypothetical propositions in regard to the matter under discussion before the hearer has passed the categorical stage. Explain, with illustrations.

5. Show the danger of arrested mental development in encouraging a passion for 'facts.' How is this to be corrected? Indicate the danger to be avoided at the opposite extreme.

CHAPTER VIII.

INFERENCE.

1. How do you distinguish an inference from an ordinary judgment?

2. The distinction between felt and conscious necessity is said to correspond to the distinction between judgment and inference. Explain.

3. Show that inference is more complex than judgment.

4. A judgment may expand or grow into an inference. Give several examples.

5. The result of an inference is always the same, no matter where we start from. Explain.

6. Contrast the *starting-point* and *course of procedure* in induction with the same in deduction.

7. In the following branches of study how did your teacher proceed, by beginning with the details and searching for a ground of connection; or by setting out the ground and proceeding to the details?—grammar, botany, geometry, algebra.

8. If you wished to learn an inflected language, how would you proceed? Would you prefer to learn by conversation, gradually adding to your vocabulary and picking up rules of grammar as you go along, or to study cases and conjugations and apply the rules in exercises?

PART III—SYSTEMS AND SYSTEM-MAKING.

CHAPTER IX.

OBSERVATION.

1. Show that every step in observation is a step towards explanation.

2. Mention some reasons why different observers going over the same ground get very different results.

3. Explain the statement that observation is something more than merely staring at things.

4. Illustrate the statement that success in observing depends far more upon brains than upon eyesight.

5. Mention some of the errors to which we are liable in observation.

6. In what way is experiment superior to observation?

7. Do you think that a good observer in one field of study is likely to be a good observer in another? Give reasons.

8. What do you consider to be the best rule to follow in observing?

9. In what field of knowledge can you observe most accurately? How do you account for your skill in this field?

CHAPTER X.

TESTIMONY.

1. Does competence in an observer always imply competence as a witness?

2. Give illustrations to show the difficulty of interpreting a statement of historical or scientific fact.

3. 'Every judgment has a ground.' Upon what ground does your judgment rest in the following?—Typhoid is due to germs. The Queen was born in 1819. Nine times eight are seventy-two. The diameter of the earth is eight thousand miles. We did right to subdue the Boers. Most of the crime of to-day is directly traceable to the liquor traffic. Strychnine is a deadly poison.

4. What do you mean by internal evidence?

5. How would you proceed to verify an historical fact?

CHAPTER XI.

CLASSIFICATION AND DEFINITION.

1. Distinguish between partition and division, giving examples.

2. In classifying what is it that determines the ground or basis?

3. Illustrate the remark that classification is a process which usually involves a series of guesses or conjectures.

4. Explain the terms genus, species, differentia, connote, denote.

5. Define, by giving genus and differentia,—system, inference, nation, province, verb, college, church, Buddhist.

6. Look carefully over your definitions to see if any are too broad or too narrow.

7. Point out any defects in the following divisions: Jews, Unitarians, Congregationalists, Episcopalians, Methodists, Catholics, Presbyterians, Lutherans, Baptists; civil wars, destructive wars, defensive wars, wars of conquest, colonial wars; rectilinear

figures into triangles, rectangles, parallelograms, polygons; rectilinear and non-rectilinear geometrical figures; liners, merchantmen, sailing vessels, men-of-war, torpedo boats; the prairie provinces, the territories, the maritime provinces, Ontario and Quebec, British Columbia.

8. In teaching grammar do you intend to furnish the pupils with ready-made definitions and classifications, or do you expect them to construct these for themselves?

9. Arrange the following terms in a system: emperor, teacher, Baptist, person, horse, heavenly body, Christian, animal, individual, Jupiter, ruler, lawyer, Alexander, planet, mammalian, solicitor, Episcopalian, Napoleon.

10. Which do you consider the most valuable intellectual exercise: to classify the words in a sentence, or the plants of the Rose family, or the goods in a general store?

CHAPTER XII.

HYPOTHESES.

1. Distinguish theory and hypothesis.

2. 'In ordinary life we are always making hypotheses.' Indicate the way in which hypotheses are employed in ordinary observation.

3. What quality do you consider essential to an hypothesis?

4. Mention the 'two distinct steps' to be taken in testing an hypothesis.

5. In seeking an hypothesis we are spurred on by *interest* and guided by *analogy*, but we must never lose sight of the *facts*. Explain.

6. 'The weight rather than the number of points of resemblance must guide us in analogy.' What is meant by the weight or importance of a point or feature?

CHAPTER XIII.

DEDUCTION.

1. In deduction, which aspect of the 'system' do we start from?

2. Give several examples of concrete and abstract systems.

3. Construct several categorical syllogisms, and express the same in hypothetical form.

4. In each of the following point out (*a*) the conclusion, (*b*) the major term, (*c*) the major premise, (*d*) the minor term, (*e*) the minor premise, (*f*) the middle term:—*M* is *n*, *p* is *m*, therefore *p* is *n*; no *x* is *y*, some *m* is *y*, therefore some *m* is not *x*; Some amphibious animals are mammalians, all mammalians are vertebrates, therefore some vertebrates are amphibious; All kings are men, and therefore fallible, for all men are fallible.

5. Give an example of a syllogism containing an undistributed middle term.

6. What do you think of the following? If the sky remains clear we shall have frost before morning; but it will be cloudy; therefore there will be no frost.

7. What fallacies are to be avoided in the hypothetical syllogism?

CHAPTER XIV.

FALLACIES.

1. How do you distinguish a valid from an invalid argument?

2. Mention three classes of errors to which we are liable in thinking.

3. Mention a few examples of failure to distinguish, and failure to identify.

4. Give instances of arguing in a circle and begging the question.

5. What is the meaning of *argumentum ad hominem*, *argumentum ad populum*, *post hoc ergo propter hoc?*

6. Distinguish between errors in interpretation and mistakes in reasoning.

7. Which of these are more frequent among children?

8. Show how fallacy may arise through misplacing the emphasis in 'Thou shalt not bear false witness against thy neighbour.' Give other examples of the same.

PART IV—CONCRETE PROBLEMS OF EDUCATION.

CHAPTER XV.

THE DEFINITION OF EDUCATION.

1. Criticise the statement that scholarship is the end of education.

2. What do you mean by the phrase 'an educated man'?

3. 'Education is a process, not a state.' Explain.

4. 'The direction of educational endeavour is determined by social needs.' Explain.

5. What is lacking in the following definitions of education: 'the harmonious development of the human powers'; 'the adaptation of man to his environment.'

6. What do you mean by 'a continuous reconstruction of one's experience with a view to making him a more socialized individual through the medium of self-control.'

CHAPTER XVI.

THE PROGRAMME OF STUDIES.

1. What is meant by an all-round programme? Is such a programme possible in an elementary school? Explain.

2. What criticisms can you offer in regard to the division of school studies into two groups, the fundamental, including the three R's, and accessory, comprising all the others?

3. What is your opinion as to the true relation between the three R's and the others?

4. If you take the ground that the three R's are incidental or instrumental rather than final how will this influence your work in school? Give several illustrations.

5. What do you mean by the 'school arts'?

6. 'Many believe firmly that a child cannot learn anything worth remembering until he has first learned to read.' Comment on this.

7. Criticize the following: 'The three R's are looked upon as barriers to be scaled before the real work of education can begin; but many children find the barrier so difficult that they never get through into the fields of knowledge.'

8. It is sometimes said that changes in school programmes are due to pedagogical forces. In your opinion what are the forces at work modifying the programmes?

9. Distinguish between a psychological basis and an objective basis of selection of studies.

10. 'The branches to be studied and the extent to which they are studied will be determined by the demands of one's civilization.' Explain this doctrine.

11. What exactly do you mean by the 'discipline of mental faculties'?

12. What arguments have you heard in favour of the doctrine of formal discipline? What is your own opinion of it?

13. What is meant by the phrase 'the mind a bundle of faculties'?

14. Show by illustration from history, geography, manual art, how the school activities may be utilized as aids to social service.

15. 'Our common school course has become a batch of miscellanies.' Indicate how it may become a system.

CHAPTER XVII.

WORK, PLAY, AND DRUDGERY IN SCHOOL.

1. What proportion of time in childhood should be devoted to work and what to play? What proportion in youth?

2. What steps will you take towards securing in your pupils the mental and moral attitude of the discoverer and inventor?

3. Looking back over your own school experience, in which of the classes mentioned in the text would you place the school you attended?

4. What advantage, mental, moral, or physical, have you ever gained through drudgery?

5. 'Children should be forced to engage in drudgery very frequently, in order to prepare them for the many disagreeable tasks that undoubtedly await them in later years.' Comment on this statement. In your opinion, who are best fitted for the performance of difficult and disagreeable tasks—drudges or good workmen?

6. Give an example of the pseudo-interest which is the result of 'making things palatable by sugar-coating.'

7. 'To speak of making things interesting is about as sensible as to speak of making sugar sweet.' Explain.

8. Comment on the statement that there is no middle course between making boys work, whether they like it or not, on the one hand, and making spineless milksops of them on the other.

9. In your own school life, did you adopt the programme of studies as your programme, or simply submit to it?

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